**Electron Microscopy Bibliography**

(SEM, TEM, Microprobe, FTIR, NMR)

Selected References— Revised April 2021

These bibliographic references have been compiled as a TSOP project, and organic petrologists have found the references to be useful in their work. They should be available at university or geological research center libraries. They are not available from TSOP.

Adeyilola, A., S. Nordeng, C. Onwumelu, F. Nwachukwu, and T. Gentzis, 2020, Geochemical, petrographic and petrophysical characterization of the Lower Bakken Shale, Divide County, North Dakota: International Journal of Coal Geology, v. 224, 103477.

Albert-Villanueva, E., A. Permanyer, J. Tritlla, G. Levresse, and R. Salas, 2016, Solid hydrocarbons in Proterozoic dolomites, Taoudeni Basin, Mauritania: Journal of Petroleum Geology, v. 39, p. 5-28.

Allen, R.M., and J.B. Vander Sande, 1984, Analysis of submicron mineral matter in coal via scanning-transmission electron microscopy: Fuel, v. 63, p. 24-29.

Ambrose, R.J., R.C. Hartman, M. Diaz-Campos, I.Y. Akkutlu, and C.H. Sondergeld, 2010, New pore-scale considerations for shale gas in place calculations: Society of Petroleum Engineers, SPE Paper 131772, 17 p.

Anovitz, L.M., D.R. Cole, A. Swift, J. Sheets, H. Elston, S. Welch, S.J. Chipera, K.C. Littrell, D.F.R. Mildner, and M.J. Wasbrough, 2014, Multiscale (nano to mm) porosity in the Eagle Ford Shale: Changes as a function of maturity: Unconventional Resources Technology Conference, URTeC 1923519, 13 p.

Anovitz, L.M., D.R. Cole, J.M. Sheets, A. Swift, H.W. Elston, S. Welch, S.J. Chipera, K.C. Littrell, D.F.R. Mildner, and M.J. Wasbrough, 2015, Effects of maturation on multiscale (nanometer to millimeter) porosity in the Eagle Ford Shale: Interpretation, v. 3, p. SU59-SU70.

Antrett, P., A. Vackiner, U. Wollenberg, G. Desbois, P. Kukla, J. Urai, H. Stollhofen, and C. Hilgers, 2011, Nano-scale porosity analysis of a Permian tight gas reservoir: AAPG Search and Discovery Article #40821, 14 p. <http://www.searchanddiscovery.com/documents/2011/40821antrett/ndx_antrett.pdf>

Ardakani, O.H., H. Sanei, A. Ghanizadeh, D. Lavoie, Z. Chen, and C.R. Clarkson, 2018, Do all fractions of organic matter contribute equally in shale porosity? A case study from Upper Ordovician Utica Shale, southern Quebec, Canada: Marine and Petroleum Geology, v. 92, p. 794-808.

Bai, B., M. Elgmati, H. Zhang, and M. Wei, 2013, Rock characterization of Fayetteville shale gas plays: Fuel, v. 105, p. 645-652.

Baisheng, N., L. Xianfeng, Y. Longlong, M. Junqing, and L. Xiangchun, 2015, Pore structure characterization of different rank coals using gas adsorption and scanning electron microscopy: Fuel, v. 158, p. 908-917.

Bandopadhyay, A.K., 2010, Determination of quartz content for Indian coals using an FTIR technique: International Journal of Coal Geology, v. 81, p. 73-78.

Baruch, E.T., M.J. Kennedy, S.C. Lőhr, and D.N. Dewhurst, 2015, Feldspar dissolution-enhanced porosity in Paleoproterozoic shale reservoir facies from the Barney Creek Formation (McArthur Basin, Australia): AAPG Bulletin, v. 99, p. 1745-1770.

Barrows, M.H., 1980, Scanning electron microscope studies of samples from the New Albany Shale Group: Scanning Electron Microscopy, v. 1980, no. 1, p. 579-586.

Bassim, N.D., B.T. de Gregorio, A.L.D. Kylcoyne, K. Scott, T. Chou, S. Wirick, G.D. Cody, and R.M. Stroud, 2012, Minimizing damage during FIB sample preparation of soft materials: Journal of Microscopy, v. 245, no. 3, p. 288-301.

Belin, S., 1992, Application of backscattered electron imaging to the study of source rocks microtextures: Organic Geochemistry, v. 18, p. 333-346.

Belin, S., 1994, Backscattered electron imaging applied to source rock sedimentology: a comparision with conventional methods in organic petrology: Bulletin Des Centres De Recherches Exploration-Production, v. 18, Special Publication, p. 165-187.

Belin, S., and C. Chenu, 1994, Staining of functional groups of source rock organic matter for scanning electron microscopy: Bulletin Des Centres De Recherches Exploration-Production, v. 18, Special Publication, p. 279-281.

Beny-Bassez, C., and J.N. Rouzaud, 1985, Characterization of carbonaceous materials by correlated electron and optical microscopy and Raman microspectroscopy: Scanning Electron Microscopy, v. 1, p. 119-132. (TEM)

Bernard, S., B. Horsfield, H.-M. Schulz, R. Wirth, A. Schreiber, and N. Sherwood, 2012, Geochemical evolution of organic-rich shales with increasing maturity: A STXM and TEM study of the Posidonia Shale (Lower Toarcian, northern Germany): Marine and Petroleum Geology, v. 31, p. 70-89.

Bernard, S., R. Wirth, A. Schreiber, H.-M. Schulz, and B. Horsfield, 2012, Formation of nanoporous pyrobitumen residues during maturation of the Barnett Shale (Fort Worth Basin): International Journal of Coal Geology, v. 103, p. 3-11.

Bernard, S., L. Brown, R. Wirth, A. Schreiber, H.-M. Schulz, B. Horsfield, A.C. Aplin, and E.J. Mathia, 2013, FIB-SEM and TEM investigations of an organic-rich shale maturation series from the Lower Toarcian Posidonia Shale, Germany: Nanoscale pore system and fluid-rock interactions, in W.K. Camp, E. Diaz, and B. Wawak, eds., Electron microscopy of shale hydrocarbon reservoirs: AAPG Memoir 102, p. 53-66.

Bernard, S., and B. Horsfield, 2014, Reply to comment on “Formation of nanoporous pyrobitumen residues during maturation of the Barnett Shale (Fort Worth Basin)”: International Journal of Coal Geology, v. 127, p. 114-115.

Bernard, S., and B. Horsfield, 2014, Thermal maturation of gas shale systems: Annual Review of Earth and Planetary Sciences, v. 42, p. 635-651.

Bishop, A.N., A.T. Kearsley, and R.L. Patience, 1992, Analysis of sedimentary organic materials by scanning electron microscopy: the application of backscattered electron imagery and light element X-ray microanalysis: Organic Geochemistry, v. 18, p. 431-446.

Blood, D.R., 2011, Sequence stratigraphy crucial to lateral placement in Marcellus Shale play, part two: American Oil & Gas Reporter, v. 54, no. 8, p. 52-60.

Boussafir, M., E. Lallier-Verges, P. Bertrand, and D. Badaut-Trauth, 1994, A TEM study of the ultrafine texture of sampled organic matter from source-rocks of the Kimmeridge Clay Formation (Yorkshire, UK): Bulletin Des Centres De Recherches Exploration-Production, v. 18, Special Publication, p. 275-277.

Boussafir, M., E. Lallier-Verges, P. Bertrand, and D. Badaut-Trauth, 1995, SEM and TEM studies on isolated organic matter and rock microfacies from a short-term organic cycle of the Kimmeridge Clay Formation (Yorkshire, G.B.), in E. Lallier-Verges, N.-P. Tribovillard, and P. Bertrand, eds., Organic matter accumulation: New York, Springer-Verlag, Lecture Notes in Earth Sciences 57, p. 15-30.

Boussafir, M., F. Gelin, E. Lallier-Verges, S. Derenne, P. Bertrand, and C. Largeau, 1995, Electron microscopy and pyrolysis of kerogens from the Kimmeridge Clay Formation, UK: source organisms, preservation processes, and origin of microcycles: Geochemica et Cosmochimica Acta, v. 59, p. 3731-3747.

Bustin, R.M., M. Mastalerz, and K.R. Wilks, 1993, Direct determination of carbon, oxygen and nitrogen content in coal using the electron microprobe: Fuel, v. 72, p. 181-185.

Bustin, R.M., M. Mastalerz, K.R. Wilks, and M.N. Lamberson, 1993, Direct major (C,O,N) and minor element analysis of macerals by electron microprobe: Energy Sources, v. 15, no. 4, p. 653-669.

Bustin, R.M., M. Mastalerz, and M. Raudsepp, 1996, Electron-probe microanalysis of light elements in coal and other kerogen: International Journal of Coal Geology, v. 32, p. 5-30.

Butcher, A.R., and H.J. Lemmens, 2011, Advanced SEM technology clarifies nanoscale properties of gas accumulations in shales: American Oil & Gas Reporter, v. 54, no. 7, p. 118-124.

Caja, M.A., J.L. Pérez-Jiménez, M.F. León, and D. Acero-Allard, 2019, Confocal laser scanning microscopy and automated petrographic image analysis in different rock types: Two-dimensional images capillary pressure curves estimation and three-dimensional porosity reconstruction: AAPG Bulletin, v. 103, p. 1963-1978.

Camp, W.K., E. Diaz, and B. Wawak, eds., 2013, Electron microscopy of shale hydrocarbon reservoirs: AAPG Memoir 102, 260 p.

Camp, W.K., and B. Wawak, 2013, Enhancing SEM grayscale images through Pseudocolor Conversion: Examples from Eagle Ford, Haynesville, and Marcellus shales, in W.K. Camp, E. Diaz, and B. Wawak, eds., Electron microscopy of shale hydrocarbon reservoirs: AAPG Memoir 102, p. 15-26.

Canter, L., S. Zhang, M. Sonnenfeld, C. Bugge, M. Guisinger, and K. Jones, 2016, Primary and secondary organic matter habit in unconventional reservoirs, in T. Olson, ed., Imaging unconventional reservoir pore systems: AAPG Memoir 112, p. 9-24.

Cao, Q., W. Zhou, H. Deng, and W. Chen, 2015, Classification and controlling factors of organic pores in continental shale gas reservoirs based on laboratory experimental results: Journal of Natural Gas Science and Engineering, v. 27, p. 1381-1388.

Cao, T., Z. Song, S. Wang, X. Cao, Y. Li, and J. Xia, 2015, Characterizing the pore structure in the Silurian and Permian shales of Sichuan Basin, China: Marine and Petroleum Geology, v. 61, p. 140-150.

Cao, T., Z. Song, S. Wang, and J. Zia, 2015, A comparative study of the specific surface area and pore structure of different shales and their kerogens: Science China Earth Science, v. 58, no. 4, p. 510-522.

Cao, T., Z. Song, H. Luo, Y. Zhou, and S. Wang, 2016, Pore system characteristics of the Permian transitional shale reservoir in the Lower Yangtze Region, China: Journal of Natural Gas Geoscience, v. 1, p. 383-395.

Cao, T., Z. Song, S. Wang, and J. Xia, 2016, Characterization of pore structure and fractal dimension of Paleozoic shales from the northeastern Sichuan Basin, China: Journal of Natural Gas Science and Engineering, v. 35, p. 882-895.

Cao, T., G. Liu, H. Liu, M. Deng, H. Yuanhong, Y. Huang, and A.S. Hursthouse, 2019, Nanoscale pore characteristics of the Upper Permian mudrocks from a transitional environment in and around eastern Sichuan Basin, China: Acta Geologica Sinica, Journal of the Geological Society of China.

Cardott, B.J., C.R. Landis, and M.E. Curtis, 2015, Post-oil solid bitumen network in the Woodford Shale, USA — A potential primary migration pathway: International Journal of Coal Geology, v. 139, p. 106-113.

Cardott, B.J., and M.E. Curtis, 2018, Identification and nanoporosity of macerals in coal by scanning electron microscopy: International Journal of Coal Geology, v. 190, p. 205-217.

Cavanaugh, T., and J. Walls, 2016, Multiresolution imaging of shales using electron and helium ion microscopy, in T. Olson, ed., Imaging unconventional reservoir pore systems: AAPG Memoir 112, p. 65-76.

Cavelan, A., M. Boussafir, C. Le Milbeau, O. Rozenbaum, and F. Laggoun-Défarge, 2019, Effect of organic matter composition on source rock porosity during confined anhydrous thermal maturation: Example of Kimmeridge-clay mudstones: International Journal of Coal Geology, v. 212, 103236.

Cavelan, A., M. Boussafir, N. Mathieu, and F. Laggoun-Défarge, 2020, Impact of thermal maturity on the concomitant evolution of the ultrafine structure and porosity of marine mudstones organic matter; contributions of electronic imaging and new spectroscopic investigations: International Journal of Coal Geology, v. 231, 103622.

Chalmers, G.R., R.M. Bustin, and I.M. Power, 2012, Characterization of gas shale pore systems by porosimetry, pycnometry, surface area, and field emission scanning electron microscopy/transmission electron microscopy image analyses: Examples from the Barnett, Woodford, Haynesville, Marcellus, and Doig units: AAPG Bulletin, v. 96, p. 1099-1119.

Chalmers, G.R.L., and R.M. Bustin, 2017, A multidisciplinary approach in determining the maceral (kerogen type) and mineralogical composition of Upper Cretaceous Eagle Ford Formation: Impact on pore development and pore size distribution: International Journal of Coal Geology, v. 171, p. 93-110.

Chen, K., X. Liu, J. Liu, C. Zhang, M. Guan, and S. Zhou, 2019, Lithofacies and pore characterization of continental shale in the second member of the Kongdian Formation in the Cangdong Sag, Bohai Bay Basin, China: Journal of Petroleum Science and Engineering, v. 177, p. 154-166.

Chen, L., Q. Kang, R. Pawar, Y.-L. He, and W.-Q. Tao, 2015, Pore-scale prediction of transport properties in reconstructed nanostructures of organic matter in shales: Fuel, v. 158, p. 650-658.

Chen, L., Z. Jiang, Q. Liu, S. Jiang, K. Liu, J. Tan, and F. Gao, 2019, Mechanism of shale gas occurrence: Insights from comparative study on pore structures of marine and lacustrine shales: Marine and Petroleum Geology, v. 104, p. 200-216.

Chen, Q., J. Zhang, X. Tang, W. Li, and Z. Li, 2016, Relationship between pore type and pore size of marine shale: An example from the Sinian-Cambrian formation, upper Yangtze region, south China: International Journal of Coal Geology, v. 158, p. 13-28.

Chen, X., X. Qu, S. Xu, W. Wang, S. Li, H. He, and Y. Liu, 2020, Dissolution pores in shale and their influence on reservoir quality in Damintun Depression, Bohai Bay Basin, east China: Insights from SEM images, N2 adsorption and fluid-rock interaction experiments: Marine and Petroleum Geology, v. 117, 104394.

Chen, Z., and C. Jiang, 2016, A revised method for organic porosity estimation in shale reservoirs using Rock-Eval data: Example from Duvernay Formation in the Western Canada Sedimentary Basin: AAPG Bulletin, v. 100, p. 405-422.

Chen, Z., Y. Song, Z. Jiang, S. Liu, Z. Li, D. Shi, W. Yang, Y. Yang, J. Song, F. Gao, K. Zhang, and X. Guo, 2019, Identification of organic matter components and organic pore characteristics of marine shale: A case study of Wufeng-Longmaxi shale in southern Sichuan Basin, China: Marine and Petroleum Geology, v. 109, p. 56-69.

Chiang, W.-S., J.-H. Chen, D. Jacobi, T. Yildirim, D. Turkoglu, S. Althaus, and Y. Liu, 2020, Structural properties of kerogens with different maturities: Energy & Fuels, v. 34, p. 12,354-12,365.

Chukwuma, K., E.M. Bordy, and A. Coetzer, 2018, Evolution of porosity and pore geometry in the Permian Whitehill Formation of South Africa — A FE-SEM image analysis study: Marine and Petroleum Geology, v. 91, p. 262-278.

Clarkson, C.R., N. Solano, R.M. Bustin, A.M.M. Bustin, G.R.L. Chalmers, L. He, Y.B. Melnichenko, A.P. Radliński, and T.P. Blach, 2013, Pore structure characterization of North American shale gas reservoirs using USANS/SANS, gas adsorption, and mercury intrusion: Fuel, v. 103, p. 606-616.

Clarkson, C.R., B. Haghshenas, A. Ghanizadeh, F. Qanbari, J.D. Williams-Kovacs, N. Riazi, C. Debuhr, and H.J. Deglint, 2016, Nanopores to megafractures: Current challenges and methods for shale gas reservoir and hydraulic fracture characterization: Journal of Natural Gas Science and Engineering, v. 31, p. 612-657.

Creelman, R.A., and C.R. Ward, 1996, A scanning electron microscope method for automated, quantitative analysis of mineral matter in coal: International Journal of Coal Geology, v. 30, p. 249-269.

Curtis, M.E., R.J. Ambrose, C.H. Sondergeld, and C.S. Rai, 2010, Structural characterization of gas shales on the micro- and nano-scales: Society of Petroleum Engineers, SPE Paper 137693, 15 p.

Curtis, M.E., R.J. Ambrose, C.H. Sondergeld, and C.S. Rai, 2011, Investigation of the relationship between organic porosity and thermal maturity in the Marcellus Shale: Society of Petroleum Engineers, SPE Paper 144370-PP, 4 p.

Curtis, M.E., R.J. Ambrose, C.H. Sondergeld, and C.S. Rai, 2011, Transmission and scanning electron microscopy investigation of pore connectivity of gas shales on the nanoscale: Society of Petroleum Engineers, SPE Paper 144391, 10 p.

Curtis, M.E., C.H. Sondergeld, R.J. Ambrose, and C.S. Rai, 2012, Microstructural investigation of gas shales in two and three dimensions using nanometer-scale resolution imaging: AAPG Bulletin, v. 96, p. 665-677.

Curtis, M.E., B.J. Cardott, C.H. Sondergeld, and C.S. Rai, 2012, Development of organic porosity in the Woodford Shale with increasing thermal maturity: International Journal of Coal Geology, v. 103, p. 26-31.

Curtis, M.E., C.H. Sondergeld, and C.S. Rai, 2013, Relationship between organic shale microstructure and hydrocarbon generation: Society of Petroleum Engineers, SPE 164540, 7 p.

Curtis, M.E., E.T. Goergen, J.D. Jernigen, C.H. Sondergeld, and C.S. Rai, 2014, Mapping of organic matter distribution on the centimeter scale with nanometer resolution: Unconventional Resources Technology Conference, URTeC 1922757, 8 p.

Cutruneo, C.M.N.L., M.L.S. Oliveira, C.R. Ward, J.C. Hower, I.A.S. de Brum, C.H. Sampaio, R.M. Kautzmann, S.R. Taffarel, E.C. Teixeira, and L.F.O. Silva, 2014, A mineralogical and geochemical study of three Brazilian coal cleaning rejects: Demonstration of electron beam applications: International Journal of Coal Geology, v. 130, p. 33-52.

Dahl, J., J.M. Moldowan, J. Walls, A. Nur, and J. DeVito, 2012, Creation of porosity in tight shales during organic matter maturation: AAPG Search and Discovery Article #40979, 36 slides. <http://www.searchanddiscovery.com/pdfz/documents/2012/40979dahl/ndx_dahl.pdf.html>

Dai, J., C. Zou, S. Liao, D. Dong, Y. Ni, J. Huang, W. Wu, D. Gong, S. Huang, and G. Hu, 2014, Geochemistry of the extremely high thermal maturity Longmaxi shale gas, southern Sichuan Basin: Organic Geochemistry, v. 74, p. 3-12.

Davis, M.R., A. White, and M.D. Deegan, 1986, Scanning electron microscopy of coal macerals: Fuel, v. 65, p. 277-280.

Dean, A., 1989, Palynomorphs from deformed low-grade metamorphic rocks: an SEM-based technique: Journal of the Geological Society, London, v. 146, part 4, p. 597-599.

Demir, I., R.D. Harvey, and K.C. Hackley, 1993, SEM-EDX and isotope characterization of the organic sulfur in macerals and chars in Illinois Basin coals: Organic Geochemistry, v. 20, p. 257-266.

Deng, H., X. Hu, H. Li, B. Luo, and W. Wang, 2016, Improved pore-structure characterization in shale formations with FESEM technique: Journal of Natural Gas Science and Engineering, v. 35, p. 309-319.

Desbois, G., J.L. Urai, and P.A. Kukla, 2009, Morphology of the pore space in claystones: evidence from BIB/FIB ion beam sectioning and cryo-SEM observations: Earth Discussions, v. 4, p. 1-19.

Dong, T., and N.B. Harris, 2013, Pore size distribution and morphology in the Horn River Shale, Middle and Upper Devonian, northeastern British Columbia, Canada, in W.K. Camp, E. Diaz, and B. Wawak, eds., Electron microscopy of shale hydrocarbon reservoirs: AAPG Memoir 102, p. 67-79.

Dong, T., N.B. Harris, K. Ayranci, C.E. Twemlow, and B.R. Nassichuk, 2015, Porosity characteristics of the Devonian Horn River shale, Canada: Insights from lithofacies classification and shale composition: International Journal of Coal Geology, v. 141-142, p. 74-90.

Dong, T., N.B. Harris, K. Ayranci, C.E. Twemlow, and B.R. Nassichuk, 2017, The impact of composition on pore throat size and permeability in high maturity shales: Middle and Upper Devonian Horn River Group, northeastern British Columbia, Canada: Marine and Petroleum Geology, v. 81, p. 220-236.

Dong, T., N.B. Harris, J.M. McMillan, C.E. Twemlow, B.R. Nassichuk, and D. L. Bish, 2019, A model for porosity evolution in shale reservoirs: An example from the Upper Devonian Duvernay Formation, Western Canada Sedimentary Basin: AAPG Bulletin, v. 103, p. 1017-1044.

Dong, T., S. He, M. Chen, Y. Hou, X. Guo, C. Wei, Y. Han, and R. Yang, 2019, Quartz types and origins in the Paleozoic Wufeng-Longmaxi Formations, eastern Sichuan Basin, China: Implications for porosity preservation in shale reservoirs: Marine and Petroleum Geology, v. 106, p. 62-73.

Dong, T., and N.B. Harris, 2020, The effect of thermal maturity on porosity development in the Upper Devonian-Lower Mississippian Woodford Shale, Permian Basin, US: Insights into the role of silica nanospheres and microcrystalline quartz on porosity preservation: International Journal of Coal Geology, v. 217, 103346.

Driskill, B., J. Walls, J. DeVito, and S.W. Sinclair, 2013, Applications of SEM imaging to reservoir characterization in the Eagle Ford Shale, south Texas, U.S.A., in W.K. Camp, E. Diaz, and B. Wawak, eds., Electron microscopy of shale hydrocarbon reservoirs: AAPG Memoir 102, p. 115-136.

Eliyahu, M., S. Emmanuel, R.J. Day-Stirrat, and C.I. Macaulay, 2015, Mechanical properties of organic matter in shales mapped at the nanometer scale: Marine and Petroleum Geology, v. 59, p. 294-304.

Emmanuel, S., M. Eliyahu, R.J. Day-Stirrat, R. Hofmann, and C.I. Macaulay, 2016, Impact of thermal maturation on nano-scale elastic properties of organic matter in shales: Marine and Petroleum Geology, v. 70, p. 175-184.

Er, C., Y. Li, J. Zhao, R. Wang, Z. Bai, and Q. Han, 2016, Pore formation and occurrence in the organic-rich shales of the Triassic Chang-7 member, Yanchang Formation, Ordos Basin, China: Journal of Natural Gas Geoscience, v. 1, p. 435-444.

Erdman, N., and N. Drenzek, 2013, Integrated preparation and imaging techniques for the microstructural and geochemical characterization of shale by scanning electron microscopy, in W.K. Camp, E. Diaz, and B. Wawak, eds., Electron microscopy of shale hydrocarbon reservoirs: AAPG Memoir 102, p. 7-14.

Fauchille, A.L., L. Ma, E. Rutter, M. Chandler, P.D. Lee, and K.G. Taylor, 2017, An enhanced understanding of the basinal Bowland shale in Lancashire (UK), through microtextural and mineralogical observations: Marine and Petroleum Geology, v. 86, p. 1374-1390.

Feng, G., Y. Zhu, G.G.X. Wang, S. Chen, Y. Wang, and W. Ju, 2019, Supercritical methane adsorption on overmature shale: Effect of pore structure and fractal characteristics: Energy & Fuels, v. 33, p. 8323-8337.

Fishman, N.S., P.C. Hackley, H.A. Lowers, R.J. Hill, S.O. Evenhoff, D.D. Eberl, and A.E. Blum, 2012, The nature of porosity in organic-rich mudstones of the Upper Jurassic Kimmeridge Clay Formation, North Sea, offshore United Kingdom: International Journal of Coal Geology, v. 103, p. 32-50.

Floss, C., C. Le Guillou, and A. Brearley, 2014, Coordinated NanoSIMS and FIB-TEM analyses of organic matter and associated matrix materials in CR3 chondrites: Geochimica et Cosmochimica Acta, v. 139, p. 1-25.

Fogden, A., T. Olson, and A.G. Christy, 2016, Nanoscale imaging of organic matter and wettability of oil-window shales, in T. Olson, ed., Imaging unconventional reservoir pore systems: AAPG Memoir 112, p. 25-42.

Gao, F., Y. Song, Z. Li, Z. Jiang, Z. Gao, X. Zhang, L. Chen, and Q. Liu, 2018, Pore characteristics and dominant controlling factors of overmature shales: A case study of the Wangyinpu and Guanyintang Formations in the Jiangxi Xiuwu Basin: Interpretation, v. 6, no. 2, p. T393-T412.

Gao, F., Y. Song, Z. Li, F. Xiong, L. Chen, Y. Zhang, Z. Liang, X. Zhang, Z. Chen, and M. Joachim, 2018, Lithofacies and reservoir characteristics of the Lower Cretaceous continental Shahezi Shale in the Changling Fault Depression of Songliao Basin, NE China: Marine and Petroleum Geology, v. 98, p. 401-421.

Gao, P., G. Liu, G.G. Lash, B. Li, D. Yan, and C. Chen, 2018, Occurrences and origin of reservoir solid bitumen in Sinian Dengying Formation dolomites of the Sichuan Basin, SW China: International Journal of Coal Geology, v. 200, p. 135-152.

Gao, Z., and Q. Hu, 2018, Pore structure and spontaneous imbibition characteristics of marine and continental shales in China: AAPG Bulletin, v. 102, p. 1941-1961.

Gao, Z., Y. Fan, Q. Hu, Z. Jiang, and Y. Cheng, 2020, The effects of pore structure on wettability and methane adsorption capability of Longmaxi Formation shale from the southern Sichuan Basin in China: AAPG Bulletin, v. 104, p. 1375-1399.

Gao, Z., Z. Liang, Q. Hu, Z. Jiang, and Q. Xuan, 2021, A new and integrated imaging and compositional method to investigate the contributions of organic matter and inorganic minerals to the pore spaces of lacustrine shale in China: Marine and Petroleum Geology, v. 127, 104962.

Garcia, L., M.Á. Caja, J. Tritlla, V. Sánchez, I. González, F.J. Gómez, and S. Quesada, 2014, State-of-the-art ion milling ablation applied to shale gas sample preparation: AAPG Search and Discovery Article #80389, 3 p. <http://www.searchanddiscovery.com/pdfz/documents/2014/80389garcia/ndx_garcia.pdf.html>

Ge, E., anc C. Wert, 1990, Spatial variation of organic sulfur in coal, in W.L. Orr and C.M. White, eds., Geochemistry of sulfur in fossil fuels: Washington, D.C., American Chemical Society Symposium Series 429, p. 316-325.

Giffin, S., R. Littke, J. Klaver, and J.L. Urai, 2013, Application of BIB-SEM technology to characterize macropore morphology in coal: International Journal of Coal Geology, v. 114, p. 85-95.

Glikson, M., 1984, Further studies on torbanites and coorongite using transmission electron microscopy and C-isotope analysis: Organic Geochemistry, v. 7, p. 161-168.

Glikson, M., and G.H. Taylor, 1986, Cyanobacterial mats: major contributors to the organic matter in Toolebuc Formation oil shales, in D.I. Gravestock, P.S. Moore, and G.M. Pitt, eds., Contributions to the geology and hydrocarbon potential of the Eromanga Basin: Geological Society of Australia Special Publication 12, p. 273-286.

Glikson, M., K. Lindsay, and J. Saxby, 1989, Botryococcus—a planktonic green alga, the source of petroleum through the ages: transmission electron microscopical studies of oil shales and petroleum source rocks: Organic Geochemistry, v. 14, p. 595-608.

Glikson, M., 2001, The application of electron microscopy and microanalysis in conjunction with organic petrology to further the understanding of organic-mineral association: examples from Mount Isa and McArthur basins, Australia: International Journal of Coal Geology, v. 47, p. 139-159.

Gonciaruk, A., M.R. Hall, M.W. Fay, C.D.J. Parmenter, C.H. Vane, A.N. Khlobystov, and N. Ripepi, 2021, Kerogen nanoscale structure and CO2 adsorption in shale micropores: Scientific Reports, v. 11, 3920.

Goral, J., I. Miskovic, J. Gelb, and M. Marsh, 2016, Correlative X-ray and electron microscopy for multi-scale characterization of heterogeneous shale reservoir pore systems, in T. Olson, ed., Imaging unconventional reservoir pore systems: AAPG Memoir 112, p. 77-88.

Goral, J., I. Walton, M. Andrew, and M. Deo, 2019, Pore system characterization of organic-rich shales using nanoscale-resolution 3D imaging: Fuel, v. 258, 116049.

Goral, J., M. Andrew, T. Olson, and M. Deo, 2020, Correlative core- to pore-scale imaging of shales: Marine and Petroleum Geology, v. 111, p. 886-904.

Gu, X., D.R. Cole, G. Rother, D.F.R. Mildner, and S.L. Brantley, 2015, Pores in Marcellus Shale: a neutron scattering and FIB-SEM study: Energy & Fuels, v. 29, p. 1295-1308.

Guan, Q., X. Lű, D. Dong, and X. Cai, 2019, Origin and significance of organic-matter pores in Upper Ordovician Wufeng-Lower Silurian Longmaxi mudstones, Sichuan Basin: Journal of Petroleum Science and Engineering, v. 176, p. 554-561.

Guo, H., R. He, W. Jia, P. Peng, Y. Lei, X. Luo, X. Wang, L. Zhang, and C. Jiang, 2018, Pore characteristics of lacustrine shale within the oil window in the Upper Triassic Yanchang Formation, southeastern Ordos Basin, China: Marine and Petroleum Geology, v. 91, p. 279-296.

Guo, X., Z. Qin, R. Yang, T. Dong, S. He, F. Hao, J. Yi, Z. Shu, H. Bao, and K. Liu, 2019, Comparison of pore systems of clay-rich and silica-rich gas shales in the lower Silurian Longmaxi formation from the Jiaoshiba area in the eastern Sichuan Basin, China: Marine and Petroleum Geology, v. 101, p. 265-280.

Grobe, A., J. Schmatz, R. Littke, J. Klaver, and J.L. Urai, 2017, Enhanced surface flatness of vitrinite particles by broad ion beam polishing and implications for reflectance measurements: International Journal of Coal Geology, v. 180, p. 113-121.

Guo, Y., J.J. Renton, and J.H. Penn, 1996, FTIR microspectroscopy of particular liptinite-rich, Late Permian coals from southern China: International Journal of Coal Geology, v. 29, p. 187-197.

Guo, Y., and R.M. Bustin, 1998, Micro-FTIR spectroscopy of liptinite macerals in coal: International Journal of Coal Geology, v. 36, p. 259-275.

Guo, Y., and R.M. Bustin, 1998, FTIR spectroscopy and reflectance of modern charcoals and fungal decayed woods: implications for studies of inertinite in coals: International Journal of Coal Geology, v. 37, p. 29-53.

Gupta, N., 2012, Multi-scale characterization of the Woodford Shale in west-central Oklahoma: from scanning electron microscope to 3D seismic: Norman, University of Oklahoma, unpublished Ph.D. dissertation, 148 p.

Gurba, L.W., and C.R. Ward, 2000, Elemental composition of coal macerals in relation to vitrinite reflectance, Gunnedah Basin, Australia, as determined by electron microprobe analysis: International Journal of Coal Geology, v. 44, p. 127-147.

Hackley, P.C., B.J. Valentine, L.M. Voortman, D.S.B. Van Oosten Slingeland, and J. Hatcherian, 2017, Utilization of integrated correlative light and electron microscopy (iCLEM) for imaging sedimentary organic matter: Journal of Microscopy, v. 267, no. 3, p. 371-383.

Hackley, P.C., C.C. Walters, S.R. Kelemen, M. Mastalerz, and H.A. Lowers, 2017, Organic petrology and micro-spectroscopy of *Tasmanites* microfossils: Applications to kerogen transformations in the early oil window: Organic Geochemistry, v. 114, p. 23-44. (micro-FTIR)

Hackley, P.C., T. Zhang, A.M. Jubb, B.J. Valentine, F.T. Dulong, and J.J. Hatcherian, 2020, Organic petrography of Leonardian (Wolfcamp A) mudrocks and carbonates, Midland Basin, Texas: The fate of oil-prone sedimentary organic matter in the oil window: Marine and Petroleum Geology, v. 112, 104086.

Hammes, U., M. Krause, and M. Mutti, 2013, Unconventional reservoir potential of the upper Permian Zechstein Group: a slope to basin sequence stratigraphic and sedimentological evaluation of carbonates and organic-rich mudrocks, northern Germany: Environmental Earth Sciences, v. 70, p. 3797-3816.

Han, C., Z. Jiang, M. Han, M. Wu, and W. Lin, 2016, The lithofacies and reservoir characteristics of the Upper Ordovician and Lower Silurian black shale in the southern Sichuan Basin and its periphery, China: Marine and Petroleum Geology, v. 75, p. 181-191.

Han, Y., B. Horsfield, R. Wirth, N. Mahlstedt, and S. Bernard, 2017, Oil retention and porosity evolution in organic-rich shales: AAPG Bulletin, v. 101, p. 807-827.

Harpalani, S., and X. Zhao, 1991, Microstructure of coal and its influence on flow of gas: Energy Sources, v. 13, no. 2, p. 229-242.

Harris, L.A., and C.S. Yust, 1976, Transmission electron microscope observation of porosity in coal: Fuel, v. 55, p. 233-236.

Harris, L.A., C.S. Yust, and R.S. Crouse, 1977, Direct determination of pyritic and organic sulphur by combined coal petrography and microprobe analysis (CPMA)—a feasibility study: Fuel, v. 56, p. 456-457.

Harris, L.A., and C.S. Yust, 1981, The ultrafine structure of coal determined by electron microscopy, in Coal structure: American Chemical Society, v. 192, p. 321-336.

Harris, L.A., O.C. Kopp, and R.S. Crouse, 1982, The application of scanning electron microscopy and ultraviolet fluorescence to a study of Chattanooga Shale specimens, in K.F.J. Heinrich, ed., Microbeam analysis–1982: San Francisco, San Francisco Press, Inc., p. 465-468.

Harrison, C.H., 1991, Electron microprobe analysis of coal macerals: Organic Geochemistry, v. 17, p. 439-449.

Heath, J.E., T.A. Dewers, B.J.O.L. McPherson, R. Petrusak, T.C. Chidsey, Jr., A.J. Rinehart, and P.S. Mozley, 2011, Pore networks in continental and marine mudstones: Characteristics and controls on sealing behavior: Geosphere, v. 7, p. 429-454.

Hou, Y., S. He, N.B. Harris, J. Yi, Y. Wang, J. Zhang, and C. Cheng, 2017, The effects of shale composition and pore structure on gas adsorption potential in highly mature marine shales, Lower Paleozoic, central Yangtze, China: Canadian Journal of Earth Sciences, v. 54, no. 10, p. 1033-1048.

Houben, M.E., A. Barnhoorn, L. Wasch, J. Trabucho-Alexandre, C.J. Peach, and M.R. Drury, 2016, Microstructures of Early Jurassic (Toarcian) shales of northern Europe: International Journal of Coal Geology, v. 165, p. 76-89.

Houben, M.E., N.J. Hardebol, A. Barnhoorn, Q.D. Boersma, A. Carone, Y. Liu, D.A.M. de Winter, C.J. Peach, and M.R. Drury, 2017, Fluid flow from matrix to fractures in Early Jurassic shales: International Journal of Coal Geology, v. 175, p. 26-39.

Hower, J.C., D. Berti, M.F. Hochella, Jr., S.M. Rimmer, and D.N. Taulbee, 2018, Submicron-scale mineralogy of lithotypes and the implications for trace element associations: Blue Gem coal, Knox County, Kentucky: International Journal of Coal Geology, v. 192, p. 73-82. (TEM)

Hu, G., Q. Pang, K. Jiao, C. Hu, and Z. Liao, 2020, Development of organic pores in the Longmaxi Formation overmature shales: Combined effects of thermal maturity and organic matter composition: Marine and Petroleum Geology, v. 116, 104314.

Hu, H., F. Hao, J. Lin, Y. Lu, Y. Ma, and Q. Li, 2017, Organic matter-hosted pore system in the Wufeng-Longmaxi (O3w-S11) shale, Jiaoshiba area, eastern Sichuan Basin, China: International Journal of Coal Geology, v. 173, p. 40-50.

Hu, H., F. Hao, X. Guo, J. Yi, Z. Shu, H. Bao, and X. Zhu, 2019, Effect of lithofacies on the pore system of over-mature Longmaxi shale in the Jiaoshiba area, Sichuan Basin, China: Marine and Petroleum Geology, v. 109, p. 886-898.

Huang, C., Y. Ju, H. Zhu, Y. Qi, K. Yu, Y. Sun, and L. Ju, 2019, Nano-scale pore structure and fractal dimension of Longmaxi Shale in the Upper Yangtze region, south China: A case study of the Laifeng-Xianfeng Block using HIM and N2 Adsorption: Minerals, v. 9, 19 p. (Helium Ion Microscope)

Huang, J., T. Cavanaugh, and B. Nur, 2013, An introduction to SEM operational principles and geologic applications for shale hydrocarbon reservoirs, in W.K. Camp, E. Diaz, and B. Wawak, eds., Electron microscopy of shale hydrocarbon reservoirs: AAPG Memoir 102, p. 1-6.

Huang, Y., K. Zhang, Z. Jiang, Y. Song, S. Jiang, C. Jia, W. Liu, M. Wen, X. Xie, T. Liu, X. Li, X. Wang, X. Liu, Y. Zhang, and L Tang, 2019, A cause analysis of the high-content nitrogen and low-content hydrocarbon in shale gas: A case study of the Early Cambrian in Xiuwu Basin, Yangtze region: Geofluids, Article ID 1435892, 13 p. (Helium Ion Microscope, HIM)

Huggins, F.E., D.A. Kosmack, G.P. Huffman, and R.J. Lee, 1980, Coal mineralogies by SEM automated image analysis: Scanning Electron Microscopy, p. 531-540.

Igersheim, A., and O. Cichocki, 1996, A simple method for microtome sectioning of prehistoric charcoal specimens, embedded in 2-hydroxyethyl methacrylate (HEMA): Review of Palaeobotany and Palynology, v. 92, p. 389-393.

İnan, S., H.A. Badairy, T. İnan, and A.A. Zahrani, 2018, Formation and occurrence of organic matter-hosted porosity in shales: International Journal of Coal Geology, v. 199, p. 39-51.

Jennings, D.S., and J. Antia, 2013, Petrographic characterization of the Eagle Ford Shale, south Texas: Mineralogy, common constituents, and distribution of nanometer-scale pore types, in W.K. Camp, E. Diaz, and B. Wawak, eds., Electron microscopy of shale hydrocarbon reservoirs: AAPG Memoir 102, p. 101-113.

Ji, L., W. Jiang, G. Cao, J. Zhou, and C. Luo, 2019, Investigation into the apparent permeability and gas-bearing property in typical organic pores in shale rocks: Marine and Petroleum Geology, v. 110, p. 871-885.

Ji, W., Y. Song, Z. Jiang, M. Meng, Q. Liu, L. Chen, P. Wang, F. Gao, and H. Huang, 2016, Fractal characteristics of nano-pores in the Lower Silurian Longmaxi shales from the Upper Yangtze Platform, south China: Marine and Petroleum Geology, v. 78, p. 88-98.

Ji, W., Y. Song, Z. Rui, M. Meng, and H. Huang, 2017, Pore characterization of isolated organic matter from high matured gas shale reservoir: International Journal of Coal Geology, v. 174, p. 31-40.

Ji, W., F. Hao, H.-M. Schulz, Y. Song, and J. Tian, 2019, The architecture of organic matter and its pores in highly mature gas shales of the lower Silurian Longmaxi Formation in the upper Yangtze platform, south China: AAPG Bulletin, v. 103, p. 2909-2942.

Jiang, S., Z. Xu, Y. Feng, J. Zhang, D. Cai, L. Chen, Y. Wu, D. Zhou, S. Bao, and S. Long, 2016, Geologic characteristics of hydrocarbon-bearing marine, transitional and lacustrine shales in China: Journal of Asian Earth Sciences, v. 115, p. 404-418.

Jiao, K., S. Yao, C. Liu, Y. Gao, H. Wu, M. Li, and Z. Tang, 2014, The characterization and quantitative analysis of nanopores in unconventional gas reservoirs utilizing FESEM-FIB and image processing: An example from the lower Silurian Longmaxi Shale, upper Yangtze region, China: International Journal of Coal Geology, v. 128-129, p. 1-11.

Jiao, K., S. Yao, K. Zhang, W. Hu, and J. Cao, 2018, The evolution of nanopores and surface roughness in naturally matured coals in south China: An atomic force microscopy and image processing study: Fuel, v. 234, p. 1123-1131.

Josh, M., L. Esteban, C. Delle Piane, J. Sarout, D.N. Dewhurst, and M.B. Clennell, 2012, Laboratory characterization of shale properties: Journal of Petroleum Science and Engineering, v. 88-89, p. 107-124.

Josh, M., C.D. Piane, L. Esteban, J. Bourdet, S. Mayo, B. Pejcic, K. Burgar, V. Luzin, M.B. Clennell, and D.N. Dewhurst, 2019, Advanced laboratory techniques characterizing solids, fluids and pores in shales: Journal of Petroleum Science and Engineering, v. 180, p. 932-949.

Ju, B., and D. Wu, 2016, Experimental study on the pore characteristics of shale rocks in Zhanhua depression: Journal of Petroleum Science and Engineering, v. 146, p. 121-128.

Kaduri, M., M. Dor, R.J. Day-Stirrat, and S. Emmanuel, 2020, Scale dependence of textural alignment in shales quantified using electron microscopy: Marine and Petroleum Geology, v. 122, 104707.

Kalaitzidis, S., and K. Christanis, 2003, Scanning electron microscope studies of the Philippi peat (NE Greece): initial aspects: International Journal of Coal Geology, v. 54, p. 69-77.

Kang, S.M., E. Fathi, R.J. Ambrose, I.Y. Akkutlu, and R.F. Sigal, 2010, Carbon dioxide storage capacity of organic-rich shales: Society of Petroleum Engineers, SPE 134583, 17 p.

Katz, B.J., and I. Arango, 2018, Organic porosity: A geochemist’s view of the current state of understanding: Organic Geochemistry, v. 123, p. 1-16.

Kelly, S., M. Johnston, B. Lee, and R.S. Martin, 2019, Kerogen-bitumen-porosity nexus: Insights from multi-basinal collocated SEM-optical light petrography: Unconventional Resources Technology Conference, URTeC 988, 18 p.

King, H.E., Jr., A.P.R. Eberle, C.C. Walters, C.E. Kliewer, D. Ertas, and C. Huynh, 2015, Pore architecture and connectivity in gas shales: Energy & Fuels, v. 29, p. 1375-1390.

Klaver, J., G. Desbois, J.L. Urai, and R. Littke, 2012, BIB-SEM study of the pore space morphology in early mature Posidonia Shale from the Hils area, Germany: International Journal of Coal Geology, v. 103, p. 12-25.

Klaver, J., G. Desbois, R. Littke, and J.L. Urai, 2015, BIB-SEM characterization of pore space morphology and distribution in postmature to overmature samples from the Haynesville and Bossier shales: Marine and Petroleum Geology, v. 59, p. 451-466.

Klaver, J., G. Desbois, R. Littke, and J.L. Urai, 2016, BIB-SEM pore characterization of mature and post mature Posidonia Shale samples from the Hils area, Germany: International Journal of Coal Geology, v. 158, p. 78-89.

Ko, L.T., R.G. Loucks, T. Zhang, S.C. Ruppel, and D. Shao, 2016, Pore and pore network evolution of Upper Cretaceous Boquillas (Eagle Ford-equivalent) mudrocks: Results from gold tube pyrolysis experiments: AAPG Bulletin, v. 100, p. 1693-1722.

Ko, L.T., R.G. Loucks, S.C. Ruppel, T. Zhang, and S. Peng, 2017, Origin and characterization of Eagle Ford pore networks in the south Texas Upper Cretaceous shelf: AAPG Bulletin, v. 101, p. 387-418.

Ko, L.T., R.G. Loucks, K.L. Milliken, Q. Liang, T. Zhang, X. Sun, P.C. Hackley, S.C. Ruppel, and S. Peng, 2017, Controls on pore types and pore-size distribution in the Upper Triassic Yanchang Formation, Ordos Basin, China: Implications for pore-evolution models of lacustrine mudrocks: Interpretation, v. 5, no. 2, p. SF127-SF148.

Ko, L.T., S.C. Ruppel, R.G. Loucks, P.C. Hackley, T. Zhang, and D. Shao, 2018, Pore-types and pore-network evolution in Upper Devonian-Lower Mississippian Woodford and Mississippian Barnett mudstones: Insights from laboratory thermal maturation and organic petrology: International Journal of Coal Geology, v. 190, p. 3-28.

Ko, L.T-W., R.G. Loucks, K.L. Milliken, T. Zhang, P.C. Hackley, R.M. Reed, S.C. Ruppel, and P. Smith, 2019, How depositional environment, diagenesis, and thermal maturity affect the evolution and significance of organic and mineral pore systems in unconventional oil and gas reservoirs: Current understanding and future research: AAPG Search and Discovery Article #80705, 50 p. <http://www.searchanddiscovery.com/pdfz/documents/2019/80705ting-wei%20ko/ndx_ting-wei%20ko.pdf.html>

Krinsley, D.H., K. Pye, S. Boggs, Jr., and N.K. Tovey, 1998, Backscattered scanning electron microscopy and image analysis of sediments and sedimentary rocks: New York, Cambridge University Press, 193 p.

Kuila, U., D.K. McCarty, A. Derkowski, T.B. Fischer, T. Topór, and M. Prasad, 2014, Nano-scale texture and porosity of organic matter and clay minerals in organic-rich mudrocks: Fuel, v. 135, p. 359-373.

Kumar, V., M.E. Curtis, N. Gupta, C.H. Sondergeld, and C.S. Rai, 2012, Estimation of elastic properties of organic matter and Woodford Shale through nano-indentation measurements: Society of Petroleum Engineers Canadian Unconventional Resources conference, SPE 162778, 11 p.

Kwiecińska, B., G. Hamburg, and J. Vleeskens, 1994, SEM study of natural cokes and associated minerals: estimated formation temperature: Bulletin Des Centres De Recherches Exploration-Production, v. 18, Special Publication, p. 293-299.

Kwiecińska, B., S. Pusz, B.J. Valentine, and ICCP, 2019, Application of electron microscopy TEM and SEM for analysis of coals, organic-rich shales and carbonaceous matter: International Journal of Coal Geology, v. 211, 103203.

Kwon, O., A.K. Kronenberg, A.F. Gangi, B. Johnson, and B.E. Herbert, 2004, Permeability of illite-bearing shale: 1. Anisotropy and effects of clay content and loading: Journal of Geophysical Research, v. 109, B10205, 19 p.

Laggoun-Defarge, F., E. Lallier-Verges, I. Suarez-Ruiz, A. Jimenez-Bautista, J.-M. Guet, and C. Clinard, 1994, Ultrafine structure of vitrinites. Relationships with optical and physical properties: Bulletin Des Centres De Recherches Exploration-Production, v. 18, Special Publication, p. 263-271.

Lallier-Verges, E., P. Bertrand, J.-M. Guet, C. Clinard, Q. Lin, and X.-Q. Wu, 1991, Ultrafine structures of vitrinites: an electron microscopy study of microlithotypes in humic coals, in P. Bertrand, ed., Coal: formation, occurrence and related properties: Bulletin de la Societe Geologique de France, v. 162, no. 2, p. 163-174.

Lan, Q., M.R. Yassin, A. Habibi, H. Dehghanpour, and J. Wood, 2015, Relative permeability of unconventional rocks with dual-wettability pore-network: Unconventional Resources Technology Conference, SPE-178549-MS/URTeC 2153642, 14 p.

Largeau, C., S. Derenne, E. Casadevall, C. Berkaloff, M. Corolleur, B. Lugardon, J.F. Raynaud, and J. Connan, 1990, Occurrence and origin of “ultralaminar” structures in “amorphous” kerogens of various source rocks and oil shales: Organic Geochemistry, v. 16, p. 889-895. (TEM)

Largeau, C., S. Derenne, C. Clairay, E. Casadevall, J.F. Raynaud, B. Lugardon, C. Berkaloff, M. Corolleur, and B. Rousseau, 1990, Characterization of various kerogens by scanning electron microscopy (SEM) and transmission electron microscopy (TEM)—morphological relationships with resistant outer walls in extant micro-organisms, in W.J.J. Fermont and J.W. Weegink, eds., International symposium on organic petrology: Mededelingen Rijks Geologische Dienst, v. 45, p. 91-101.

Laurent, P., 1994, Roles of hydrogen and pressure in coal (micro)textural evolution during hydropyrolysis: Bulletin Des Centres De Recherches Exploration-Production, v. 18, Special Publication, p. 301-315.

Lee, A., and G.H. Taylor, 1999, A comparison of electron staining agents for the transmission electron microscopy examination of coal: International Journal of Coal Geology, v. 329-337.

Lei, Y., X. Luo, X. Wang, L. Zhang, C. Jiang, W. Yang, Y. Yu, M Cheng, and L. Zhang, 2015, Characteristics of silty laminae in Zhangjiatan Shale of southeastern Ordos Basin, China: Implications for shale gas formation: AAPG Bulletin, v. 99, p. 661-687.

Lemmens, H., and D. Richards, 2013, Multiscale imaging of shale samples in the scanning electron microscope, in W.K. Camp, E. Diaz, and B. Wawak, eds., Electron microscopy of shale hydrocarbon reservoirs: AAPG Memoir 102, p. 27-35.

Li, A., W. Ding, J. He, P. Dai, S. Yin, and F. Xie, 2016, Investigation of pore structure and fractal characteristics of organic-rich shale reservoirs: A case study of Lower Cambrian Qiongzhusi Formation in Malong block of eastern Yunnan Province, south China: Marine and Petroleum Geology, v. 70, p. 46-57.

Li, A., W. Ding, K. Jiu, Z. Wang, R. Wang, and J. He, 2018, Investigation of the pore structures and fractal characteristics of marine shale reservoirs using NMR experiments and image analyses: A case study of the Lower Cambrian Niutitang Formation in northern Guizhou Province, South China: Marine and Petroleum Geology, v. 89, p. 530-540.

Li, H., H. Tang, and M. Zheng, 2019, Micropore structural heterogeneity of siliceous shale reservoir of the Longmaxi Formation in the southern Sichuan Basin, China: Minerals, v. 9, 20 p.

Li, J., J. Yin, Y. Zhang, S. Lu, W. Wang, J. Li, F. Chen, and Y. Meng, 2015, A comparison of experimental methods for describing shale pore features — A case study in the Bohai Bay Basin of eastern China: International Journal of Coal Geology, v. 152, Part B, p. 39-49.

Li, J., S. Zhou, Y. Li, Y. Ma, Y. Yang, and C. Li, 2016, Effect of organic matter on pore structure of mature lacustrine organic-rich shale: A case study of the Triassic Yanchang shale, Ordos Basin, China: Fuel, v. 185, p. 421-431.

Li, J., P. Zhang, S. Lu, C. Chen, H. Xue, S. Wang, and W. Li, 2018, Scale-dependent nature of porosity and pore size distribution in lacustrine shales: An investigation by BIB-SEM and X-Ray CT methods: Journal of Earth Science.

Li, T., Z. Jiang, C. Xu, B. Liu, G. Liu, P. Wang, X. Li, W. Chen, C. Ning, and Z. Wang, 2017, Effect of pore structure on shale oil accumulation in the lower third member of the Shahejie Formation, Zhanhua Sag, eastern China: Evidence from gas adsorption and nuclear magnetic resonance: Marine and Petroleum Geology, v. 88, p. 932-949.

Li, W., S. Lu, H. Xue, P. Zhang, and Y. Hu, 2016, Microscopic pore structure in shale reservoir in the argillaceous dolomite from the Jianghan Basin: Fuel, v. 181, p. 1041-1049.

Li, W., W. Wang, S. Lu, and H. Xue, 2017, Quantitative characterization on shale-hosted oil reservoir: A case study of argillaceous dolomite reservoir in the Jianghan Basin: Fuel, v. 206, p. 690-700.

Li, X., G. Chen, Z. Chen, L. Wang, Y. Wang, D. Dong, Z. Lű, W. Lű, S. Wang, J. Huang, and C. Zhang, 2016, An insight into the mechanism and evolution of shale reservoir characteristics with over-high maturity: Journal of Natural Gas Geoscience, v. 1, p. 373-382.

Li, X., Z. Jiang, P. Wang, Y. Song, Z. Li, X. Tang, T. Li, G. Zhai, S. Bao, C. Xu, and F. Wu, 2018, Porosity-preserving mechanisms of marine shale in Lower Cambrian of Sichuan Basin, south China: Journal of Natural Gas Science and Engineering, v. 55, p. 191-205.

Li, X., H. Zhu, K. Zhang, Z. Li, Y. Yu, X. Feng, and Z. Wang, 2021, Pore characteristics and pore structure deformation evolution of ductile deformed shales in the Wufeng-Longmaxi Formation, southern China: Marine and Petroleum Geology, v. 127, 104992.

Li, Y., C. Zhang, D. Tang, Q. Gan, X. Niu, K. Wang, and R. Shen, 2017, Coal pore size distributions controlled by the coalification process: An experimental study of coals from the Junggar, Ordos and Qinshui Basins in China: Fuel, v. 206, p. 352-363.

Li, Y., J. Schieber, T. Fan, and X. Wei, 2018, Pore characterization and shale facies analysis of the Ordovician-Silurian transition of northern Guizhou, south China: The controls of shale facies on pore distribution: Marine and Petroleum Geology, v. 92, p. 697-718. (no pores in graptolites)

Li, Z., P.M. Fredericks, L. Rintoul, and C.R. Ward, 2007, Application of attenuated total reflectance micro-Fourtier transform infrared (ATR-FTIR) spectroscopy to the study of coal macerals: Examples from the Bowen Basin, Australia: International Journal of Coal Geology, v. 70, p. 87-94.

Li, Z., D. Liu, Y. Cai, P.G. Ranjith, and Y. Yao, 2017, Multi-scale quantitative characterization of 3-D pore-fracture networks in bituminous and anthracite coals using FIB-SEM tomography and X-ray µ-CT: Fuel, v. 209, p. 43-53.

Li, Z., Z. Liang, Z. Jiang, F. Gao, Y. Zhang, H. Yu, L. Xiao, and Y. Yang, 2019, The impacts of matrix compositions on nanopore structure and fractal characteristics of lacustrine shales from the Changling Fault Depression, Songliao Basin, China: Minerals, v. 9, 21 p.

Li, Z., Z. Jiang, H. Yu, and Z. Liang, 2019, Organic matter pore characterization of the Wufeng-Longmaxi shales from the Fuling gas field, Sichuan Basin: Evidence from organic matter isolation and low-pressure CO2 and N2 adsorption: Energies, 12, 1207, 15 p.

Liu, B., J. Schieber, and M. Mastalerz, 2018, Combined SEM and reflected light petrography of organic matter in the New Albany Shale (Devonian-Mississippian) in the Illinois Basin: A perspective on organic pore development with thermal maturation: International Journal of Coal Geology, v. 184, p. 57-72.

Liu, H., S. Zhang, G. Song, W. Xuejun, J. Teng, M. Wang, Y. Bao, S. Yao, W. Wang, S. Zhang, Q. Hu, and Z. Fang, 2019, Effect of shale diagenesis on pores and storage capacity in the Paleogene Shahejie Formation, Dongying Depression, Bohai Bay Basin, east China: Marine and Petroleum Geology, v. 103, p. 738-752.

Liu, D., Z. Li, Z. Jiang, C. Zhang, Z. Zhang, J. Wang, D. Yang, Y. Song, and Q. Luo, 2019, Impact of laminae on pore structures of lacustrine shales in the southern Songliao Basin, NE China: Journal of Asian Earth Sciences, v. 182, 14 p.

Liu, K., M. Ostadhassan, T. Gentzis, H. Carajal-Ortiz, and B. Bubach, 2018, Characterization of geochemical properties and microstructures of the Bakken Shale in North Dakota: International Journal of Coal Geology, v. 190, p. 84-98.

Liu, K., M. Ostadhassan, T. Gentzis, and H. Fowler, 2019, Image analysis of the pore structures: An intensive study for Middle Bakken: Journal of Natural Gas Science and Engineering, v. 61, p. 32-45.

Liu, R., Z. Liu, P. Sun, X. Yang, and C. Zhang, 2017, Shale gas accumulation potential of the Upper Cretaceous Qingshankou Formation in the southeast Songliao Basin, NE China: Marine and Petroleum Geology, v. 86, p. 547-562.

Liu, R., F. Hao, T. Engelder, Z. Shu, J. Yi, S. Xu, and C. Teng, 2020, Influence of tectonic exhumation on porosity of Wufeng–Longmaxi shale in the Fuling gas field of the eastern Sichuan Basin, China: AAPG Bulletin, v. 104, p. 939-959.

Liu, X., J. Wang, L. Ge, F. Hu, C. Li, X. Li, J. Yu, H. Xu, S. Lu, and Q. Xue, 2017, Pore-scale characterization of tight sandstone in Yanchang Formation Ordos Basin China using micro-CT and SEM imaging from nm- to cm-scale: Fuel, v. 209, p. 254-264.

Liu, X., B. Nie, W. Wang, Z. Wang, and L. Zhang, 2019, The use of AFM in quantitative analysis of pore characteristics in coal and coal-bearing shale: Marine and Petroleum Geology, v. 105, p. 331-337.

Liu, Y., Y. Zhu, W. Li, C. Zhang, and Y. Wang, 2017, Ultra micropores in macromolecular structure of subbituminous coal vitrinite: Fuel, v. 210, p. 298-306. (NMR)

Liu, Y., Y. Zhu, S. Liu, and W. Li, 2018, A hierarchical methane adsorption characterization through a multiscale approach by considering the macromolecular structure and pore size distribution: Marine and Petroleum Geology, v. 96, p. 304-314.

Liu, Y., Y. Zhu, S. Chen, Y. Wang, and Y. Song, 2018, Evaluation of spatial alignment of kerogen in shale using high-resolution Transmission Electron Microscopy, Raman Spectroscopy, and Fourier Transform Infrared: Energy & Fuels, v. 32, p. 10616-10627. (TEM, FT-IR)

Liu, Y., Y. Zhu, S. Liu, and C. Zhang, 2020, Evolution of aromatic clusters in vitrinite-rich coal during thermal maturation by using high-resolution transmission electron microscopy and Fourier Transform Infrared measurements: Energy Fuels, v. 34, p. 10781-10792. (TEM, FTIR)

Liu, Z., B. Gao, Z. Hu, W. Du, H. Nie, and T. Jiang, 2018, Pore characteristics and formation mechanism of high-maturity organic-rich shale in Lower Cambrian Jiumenchong Formation, southern Guizhou: Petroleum Research, v. 3, p. 57-65.

Lőhr, S.C., E.T. Baruch, P.A. Hall, and M.J. Kennedy, 2015, Is organic pore development in gas shales influenced by the primary porosity and structure of thermally immature organic matter?: Organic Geochemistry, v. 87, p. 119-132.

Loucks, R.G., R.M. Reed, S.C. Ruppel, and D.M. Jarvie, 2009, Morphology, genesis, and distribution of nanometer-scale pores in siliceous mudstones of the Mississippian Barnett Shale: Journal of Sedimentary Research, v. 79, p. 848-861. (SEM of Ar-ion-beam milling)

Loucks, R.G., R.M. Reed, S.C. Ruppel, and U. Hammes, 2010, Preliminary classification of matrix pores in mudrocks: Gulf Coast Association of Geological Societies Transactions, v. 60, p. 435-441.

Loucks, R.G., R.M. Reed, S.C. Ruppel, and U. Hammes, 2012, Spectrum of pore types and networks in mudrocks and a descriptive classification for matrix-related mudrock pores: AAPG Bulletin, v. 96, p. 1071-1098.

Loucks, R.G., and R.M. Reed, 2014, Scanning-electron-microscope petrographic evidence for distinguishing organic matter pores associated with in-place organic matter versus migrated organic matter in mudrocks: Gulf Coast Association of Geological Societies Journal, v. 3, p. 51-60. [distinguish depositional (kerogen), pre-oil (bitumen), and post-oil (pyrobitumen)]

Loucks, R.G., S.C. Ruppel, X. Wang, L. Ko, S. Peng, T. Zhang, H.D. Rowe, and P. Smith, 2017, Pore types, pore-network analysis, and pore quantification of the lacustrine shale-hydrocarbon system in the Late Triassic Yanchang Formation in the southeastern Ordos Basin, China: Interpretation, v. 5, no. 2, p. SF63-SF79.

Loucks, R.G., and S.P. Dutton, 2019, Insights into deep, onshore Gulf of Mexico Wilcox sandstone pore networks and reservoir quality through the integration of petrographic, porosity and permeability, and mercury injection capillary pressure analyses: AAPG Bulletin, v. 103, p. 745-765.

Lu, H., A. Zhao, H. Tang, L. Lu, and L. Jiang, 2020, Pore characterization and its controlling factors in the Wufeng-Longmaxi shale of North Guizhou, southwest China: Energy Fuels, v. 34, p. 15,763-15,772.

Lu, J., T.E. Larson, and R.C. Smyth, 2015, Carbon isotope effects of methane transport through Anahuac Shale—A core gas study: Journal of Geochemical Exploration, v. 148, p. 138-149.

Lu, J., S.C. Ruppel, and H.D. Rowe, 2015, Organic matter pores and oil generation in the Tuscaloosa marine shale: AAPG Bulletin, v. 99, p. 333-357.

Lu, X., P. Sjövall, H. Soenen, and M. Andersson, 2018, Microstructures of bitumen observed by environmental scanning electron microscopy (ESEM) and chemical analysis using time-of-flight secondary ion mass spectrometry (TOF-SIMS): Fuel, v. 229, p. 198-208.

Luo, G., N. Zhong, N. Dai, and W. Zhang, 2016, Graptolite-derived organic matter in the Wufeng-Longmaxi Formations (Upper Ordovician–Lower Silurian) of southeastern Chongqing, China: Implications for gas shale evaluation: International Journal of Coal Geology, v. 153, p. 87-98.

Luo, P., and N. Zhong, 2020, The role of residual bitumen on the pore structure of organic-rich shales from low to over mature: Insight from shale and coal samples after the hydrous pyrolysis: International Journal of Coal Geology, v. 226, 103515.

Luo, W., M. Hou, X. Liu, S. Huang, H. Chao, R. Zhang, and X. Deng, 2018, Geological and geochemical characteristics of marine-continental transitional shale from the Upper Permian Longtan Formation, northwestern Guizhou, China: Marine and Petroleum Geology, v. 89, p. 58-67.

Lyons, P.C., C.A. Palmer, R.M. Bustin, and A.M. Vassallo, eds., 1996, New techniques in the chemical analysis of coal: International Journal of Coal Geology, v. 32, 312 p.

Ma, L., K.G. Taylor, P.D. Lee, K.J. Dobson, P.J. Dowey, and L. Courtois, 2016, Novel 3D centimeter-to nano-scale quantification of an organic-rich mudstone: The Carboniferous Bowland Shale, northern England: Marine and Petroleum Geology, v. 72, p. 193-205.

Ma, L., K.G. Taylor, P.J. Dowey, L. Courtois, A. Gholinia, and P.D. Lee, 2017, Multi-scale 3D characterization of porosity and organic matter in shales with variable TOC content and thermal maturity: Examples from the Lublin and Baltic Basins, Poland and Lithuania: International Journal of Coal Geology, v. 180, p. 100-112.

Ma, L., K.G. Taylor, P.J. Dowey, L. Courtois, A. Gholinia, and P.D. Lee, 2017, Multi-scale 3D characterization of porosity and organic matter in shales with variable TOC content and thermal maturity: Examples from the Lublin and Baltic Basins, Poland and Lithuania: International Journal of Coal Geology, v. 180, p. 100-112.

Ma, Y., N. Zhong, D. Li, Z. Pan, L. Cheng, and K. Liu, 2015, Organic matter/clay mineral intergranular pores in the Lower Cambrian Lujiaping Shale in the north-eastern part of the upper Yangtze area, China: A possible microscopic mechanism for gas preservation: International Journal of Coal Geology, v. 137, p. 38-54.

Ma, Y., N. Zhong, L. Cheng, Z. Pan, N. Dai, Y. Zhang, and L. Yang, 2016, Pore structure of the graptolite-derived OM in the Longmaxi Shale, southeastern Upper Yangtze region, China: Marine and Petroleum Geology, v. 72, p. 1-11.

Ma, Y., O.H. Ardakani, N. Zhong, H. Liu, H. Huang, S. Larter, and C. Zhang, 2020, Possible pore structure deformation effects on the shale gas enrichment: An example from the Lower Cambrian shales of the eastern Upper Yangtze Platform, south China: International Journal of Coal Geology, v. 117, 103349.

Ma, Z., L. Zheng, X. Xu, F. Bao, and X. Yu, 2018, Thermal simulation experiment of organic matter-rich shale and implication for organic pore formation and evolution: Petroleum Research, v. 2, p. 347-354.

Machnikowska, H., A. Krztoń, and J. Machnikowski, 2002, The characterization of coal macerals by diffuse reflectance infrared spectroscopy: Fuel, v. 81, p. 245-252.

Manjunath, G.L., and R.R. Nair, 2017, Microscale assessment of 3D geomechanical structural characterization of Gondwana shales: International Journal of Coal Geology, v. 181, p. 60-74.

Mann, U., J.D. Neisel, W.-G. Burchard, V. Heinen, and D.H. Welte, 1994, Fluid-rock interfaces as revealed by cryo-scanning electron microscopy: European Association of Geoscientists and Engineers, First Break, v. 12, p. 131-136.

Mao, W., and S. Guo, 2018, Comparison of factors influencing pore size distributions in marine, terrestrial, and transitional shales of similar maturity in China: Energy & Fuels, v. 32, p. 8145-8153.

Masran, T.C., and S.A.J. Pocock, 1981, The classification of plant-derived particulate organic matter in sedimentary rocks, in J. Brooks, ed., Organic maturation studies and fossil fuel exploration: San Francisco, Academic Press, p. 145-175.

Mastalerz, M., and R.M. Bustin, 1993, Variation in elemental composition of macerals; an example of the application of electron microprobe to coal studies: International Journal of Coal Geology, v. 22, p. 83-99.

Mastalerz, M., and R.M. Bustin, 1993, Electron microprobe and micro-FTIR analyses applied to maceral chemistry: International Journal of Coal Geology, v. 24, p. 333-345.

Mastalerz, M., and R.M. Bustin, 1993, Variation in maceral chemistry within and between coals of varying rank: an electron microprobe and micro-FTIR investigation: Journal of Microscopy, v. 171, p. 153-166.

Mastalerz, M., and R.M. Bustin, 1995, Application of reflectance micro-Fourier Transform Infrared spectrometry in studying coal macerals: comparison with other Fourier Transform Infrared techniques: Fuel, v. 74, p. 536-542.

Mastalerz, M., and R.M. Bustin, 1996, Application of reflectance micro-Fourier Transform Infrared analysis to the study of coal macerals: an example from the Late Jurassic to Early Cretaceous coals of the Mist Mountain Formation, British Columbia, Canada: International Journal of Coal Geology, v. 32, p. 55-67.

Mastalerz, M., J.C. Hower, and A. Carmo, 1998, In situ FTIR and flash pyrolysis/GC-MS characterization of Protosalvinia (Upper Devonian, Kentucky, USA): implications for maceral classification: Organic Geochemistry, v. 28, p. 57-66.

Mastalerz, M., and L.W. Gurba, 2001, Determination of nitrogen in coal macerals using electron microprobe technique—experimental procedure: International Journal of Coal Geology, v. 47, p. 23-30.

Mastalerz, M., L. He, and Y.B. Melnichenko, 2012, Porosity of coal and shale: insights from gas adsorption and SANS/USANS techniques: Energy Fuels, v. 26, p. 5109-5120.

Mastalerz, M., A. Schimmelmann, A. Drobniak, and Y. Chen, 2013, Porosity of Devonian and Mississippian New Albany Shale across a maturation gradient: Insights from organic petrology, gas adsorption, and mercury intrusion: AAPG Bulletin, v. 97, p. 1621-1643.

Mastalerz, M., C. Gasawal, F. Krause, C. Clarkson, and C. DeBuhr, 2017, Applicability of Micro-FTIR in detecting shale heterogeneity: AAPG Search and Discovery Article No. 51360, 33 p. <http://www.searchanddiscovery.com/pdfz/documents/2017/51360mastalerz/ndx_mastalerz.pdf.html>

Mastalerz, M., and J. Schieber, 2017, Effect of ion milling on the perceived maturity of shale samples: Implications for organic petrography and SEM analysis: International Journal of Coal Geology, v. 183, p. 110-119.

Mathia, E.J., L. Brown, K.M. Thomas, and A.C. Aplin, 2016, Evolution of porosity and pore types in organic-rich, calcareous, Lower Toarcian Posidonia Shale: Marine and Petroleum Geology, v. 75, p. 117-139.

McCartney, J.T., H.J. O’Donnell, and S. Ergun, 1966, Ultrafine structures in coal components as revealed by electron microscopy, in R.F. Gould, ed., Coal science: American Chemical Society Advances in Chemistry Series 55, p. 261-273.

Mehmani, A., and M. Prodanović, 2014, The application of sorption hysteresis in nano-petrophysics using multiscale multiphysics network models: International Journal of Coal Geology, v. 128-129, p. 96-108.

Milliken, K.L., W.L. Esch, R.M. Reed, and T. Zhang, 2012, Grain assemblages and strong diagenetic overprinting in siliceous mudrocks, Barnett Shale (Mississippian), Fort Worth Basin, Texas: AAPG Bulletin, v. 96, p. 1553-1578.

Milliken, K.L., M. Rudnicki, D.N. Awwiller, and T. Zhang, 2013, Organic matter-hosted pore system, Marcellus Formation (Devonian), Pennsylvania: AAPG Bulletin, v. 97, p. 177-200.

Milliken, K.L., L.T. Ko, M. Pommer, and K.M. Marsaglia, 2014, SEM petrography of eastern Mediterranean sapropels: analogue data for assessing organic matter in oil and gas shales: Journal of Sedimentary Research, v. 84, p. 961-974.

Milliken, K.L., and M.E. Curtis, 2016, Imaging pores in sedimentary rocks: Foundation of porosity prediction: Marine and Petroleum Geology, v. 73, p. 590-608.

Milliken, K.L.., and T. Olson, 2016, Amorphous and crystalline solids as artifacts in SEM images, in T. Olson, ed., Imaging unconventional reservoir pore systems: AAPG Memoir 112, p. 1-8.

Milner, M., R. McLin, and J. Petriello, 2010, Imaging texture and porosity in mudstones and shales: Comparison of secondary and ion milled backscatter SEM methods: Canadian Unconventional Resources and International Petroleum Conference, Calgary, Alberta, Canada, October 19-21, 1010, Canadian Society for Unconventional Gas/Society of Petroleum Engineers Paper 138975, 10 p.

Misch, D., F. Mendez-Martin, G. Hawranek, P. Onuk, D. Gross, and R.F. Sachsenhofer, 2016, SEM and FIB-SEM investigations on potential gas shales in the Dniepr-Donets Basin (Ukraine): pore space evolution in organic matter during thermal maturation: IOP Conference Series, Materials Science and Engineering, v. 109, 13 p.

Misch, D., D. Gross, N. Mahlstedt, V. Makogon, and R.F. Sachsenhofer, 2016, Shale gas/shale oil potential of Upper Visean black shales in the Dniepr-Donets Basin (Ukraine): Marine and Petroleum Geology, v. 75, p. 203-219.

Misch, D., J. Klaver, D. Gross, J. Rustamov, R.F. Sachsenhofer, J. Schmatz, and J.L. Urai, 2018, Pore space characteristics of the Upper Visean ‘Rudov Beds’: Insights from broad ion beam scanning electron microscopy and organic geochemical investigations, in P. Downey, M. Osborne, and H. Volk, eds., Application of analytical techniques to petroleum systems: London, Geological Society, Special Publication 484.

Mishra, D.K., S.K. Samad, A.K. Varma, and V.A. Mendhe, 2018, Pore geometrical complexity and fractal facets of Permian shales and coals from Auranga Basin, Jharkhand, India: Journal of Natural Gas Science and Engineering, v. 52, p. 25-43.

Modica, C.J., and S.G. Lapierre, 2012, Estimation of kerogen porosity in source rocks as a function of thermal transformation: Example from the Mowry Shale in the Powder River Basin of Wyoming: AAPG Bulletin, v. 96, p. 87-108.

Morga, R., 2010, Chemical structure of semifusinite and fusinite of steam and coking coal from the Upper Silesian Coal Basin (Poland) and its changes during heating as inferred from micro-FTIR analysis: International Journal of Coal Geology, v. 84, p. 1-15.

Morga, R., and M. Kamińska, 2018, The chemical composition of graptolite periderm in the gas shales from the Baltic Basin of Poland: International Journal of Coal Geology, v. 199, p. 10-18.

Munnecke, A., and T. Servais, 1996, Scanning electron microscopy of polished, slightly etched rock surfaces: a method to observe palynomorphs in situ: Palynology, v. 20, p. 163-176.

Nie, H., Z. Jin, and J. Zhang, 2018, Characteristics of three organic matter pore types in the Wufeng-Longmaxi Shale of the Sichuan Basin, southwest China: Scientific Reports, v. 8, Article 7014, 11 p. <https://www.nature.com/articles/s41598-018-25104-5>

Nie, H., Z. Jin, C. Sun, Z. He, G. Liu, and Q. Liu, 2019, Organic matter types of the Wufeng and Longmaxi Formations in the Sichuan Basin, south China: Implications for the formation of organic matter pores: Energy & Fuels, v. 33, p. 8076-8100.

Niu, Q., J. Pan, L. Cao, Z. Ji, H. Wang, K. Wang, and Z. Wang, 2017, The evolution and formation mechanisms of closed pores in coal: Fuel, v. 200, p. 555-563.

Nix, T., and S. Feist-Burkhardt, 2003, New methods applied to the microstructure analysis of Messel oil shale: confocal laser scanning microscopy (CLSM) and environmental scanning electron microscopy (ESEM): Geological Magazine, v. 140, p. 469-478.

Norbisrath, J.H., G.P. Eberli, B.Laurich, G. Desbois, R.J. Weger, and J.L. Urai, 2015, Electrical and fluid flow properties of carbonate microporosity types from multiscale digital image analysis and mercury injection: AAPG Bulletin, v. 99, p. 2077-2098.

Oberlin, A., J.L. Boulmier, and M. Villey, 1980, Electron microscopic study of kerogen microstructure. Selected criteria for determining the evolution path and evolution stage of kerogen, in B. Durand, ed., Kerogen—Insoluble organic matter from sedimentary rocks: Paris, Editions Technip, p. 191-241.

O’Brien, N.R., C.A. McRobbie, R.M. Slatt, and E.T. Baruch-Jurado, 2016, Unconventional gas–oil shale microfabric features relating to porosity, storage, and migration of hydrocarbons, in T. Olson, ed., Imaging unconventional reservoir pore systems: AAPG Memoir 112, p. 43-64.

Olson, T., ed., 2016, Imaging unconventional reservoir pore systems: AAPG Memoir 112, 231 p.

Ougier-Simonin, A., F. Renard, C. Boehm, and S. Vidal-Gilbert, 2016, Microfracturing and microporosity in shales: Earth-Science Reviews, v. 162, p. 198-226.

Pacton, M., N. Fiet, and G. Gorin, 2006, Revisiting amorphous organic matter in Kimmeridgian laminites: what is the role of the vulcanization process in the amorphization of organic matter?: Terra Nova, v. 18, p. 380-387. (TEM)

Pan, J., K. Wang, Q. Hou, Q. Niu, H. Wang, and Z. Ji, 2015, Micro-pores and fractures of coals analysed by field emission scanning electron microscopy and fractal theory: Fuel, v. 164, p. 277-285.

Passey, Q.R., K.M. Bohacs, W.L. Esch, R. Klimentidis, and S. Sinha, 2010, From oil-prone source rock to gas-producing shale reservoir—Geologic and petrophysical characterization of unconventional shale-gas reservoirs: Society of Petroleum Engineers, Paper 131350, 29 p.

Peng, N., S. He, Q. Hu, B. Zhang, X. He, G. Zhai, C. He, and R. Yang, 2019, Organic nanopore structure and fractal characteristics of Wufeng and lower member of Longmaxi shales in southeastern Sichuan, China: Marine and Petroleum Geology, v. 103, p. 456-472.

Piane, C.D., J. Bourdet, M. Josh, M.B. Clennell, W.D.A. Rickard, M. Saunders, N. Sherwood, Z. Li, D.N. Dewhurst, and M.D. Raven, 2018, Organic matter network in post-mature Marcellus Shale: Effects on petrophysical properties: AAPG Bulletin, v. 102, p. 2305-2332.

Pierre, A.O.E., K. Mageau, P. Miller, A. Cox, A. Shelby-James, and T. Branter, 2019, Sweet spot and porosity development in an unconventional source rock play, in Carbonate pore systems: New developments and case studies: SEPM Special Publication No. 112, p. 73-93.

Pommer, M.E., K.L. Milliken, and A. Ozkan, 2014, Pore types across thermal maturity: Eagle-Ford Formation, south Texas: AAPG Search and Discovery Article #50987, 22 slides. <http://www.searchanddiscovery.com/pdfz/documents/2014/50987pommer/ndx_pommer.pdf.html>

Pommer, M., and K. Milliken, 2015, Pore types and pore-size distributions across thermal maturity, Eagle Ford Formation, southern Texas: AAPG Bulletin, v. 99, p. 1713-1744.

Poole, I., and G.E. Lloyd, 2000, Alternative SEM techniques for observing pyritised fossil material: Review of Palaeobotany and Palynology, v. 112, p. 287-295.

Presswood, S.M., S.M. Rimmer, K.B. Anderson, and J. Filiberto, 2016, Geochemical and petrographic alteration of rapidly heated coals from the Herrin (No. 6) coal seam, Illinois Basin: International Journal of Coal Geology, v. 165, p. 243-256. (micro-FTIR)

Raymond, R., Jr., 1982, Electron probe microanalysis—a means of direct determination of organic sulfur in coal, in E.L. Fuller, Jr., ed., Coal and coal products: analytical characterization techniques: American Chemical Society, series 205, p. 191-203.

Reed, R.M., R.G. Loucks, D.M. Jarvie, and S.C. Ruppel, 2007, Nanopores in the Mississippian Barnett Shale: Distribution, morphology, and possible genesis (abstract): Geological Society of America, Annual Meeting, Abstracts with Programs, v. 39, no. 6, p. 358.

Reed, R.M., R. Loucks, and K.L. Milliken, 2012, Heterogeneity of shape and microscale spatial distribution in organic-matter-hosted pores of gas shales: AAPG Annual Convention and Exhibition, Long Beach, CA, abstract 1236631.

Reed, R.M., R.G. Loucks, and S.C. Ruppel, 2014, Comment on “Formation of nanoporous pyrobitumen residues during maturation of the Barnett Shale (Fort Worth Basin)” by Bernard et al. (2012): International Journal of Coal Geology, v. 127, p. 111-113.

Reed, R.M., and R.G. Loucks, 2015, Low-thermal-maturity (<0.7% VR) mudrock pore systems: Mississippian Barnett Shale, southern Fort Worth Basin: Gulf Coast Association of Geological Societies, v. 4, p. 15-28.

Reed, R.M., R.G. Loucks, and L.T. Ko, 2017, Pores observed in organic matter in mudrocks: A ten-year retrospective (abstract): AAPG Search and Discovery Article #90291. <http://www.searchanddiscovery.com/abstracts/html/2017/90291ace/abstracts/2605375.html>

Reed, R.M., 2017, Organic-matter pores: new findings from lower-thermal-maturity mudrocks: GCAGS Journal, v. 6, p. 99-110.

Reed, S.J.B., 2005, Electron microprobe analysis and scanning electron microscopy in geology, second edition: New York, Cambridge University Press, 192 p.

Remeysen, K., and R. Swennen, 2006, Beam hardening artifact reduction in microfocus computed tomography for improved quantitative coal characterization: International Journal of Coal Geology, v. 67, p. 101-111.

Rine, J.M., E. Smart, W. Dorsey, K. Hooghan, and M. Dixon, 2013, Comparison of porosity distribution within selected North American shale units by SEM examination of argon-ion-milled samples, in W.K. Camp, E. Diaz, and B. Wawak, eds., Electron microscopy of shale hydrocarbon reservoirs: AAPG Memoir 102, p. 137-152.

Rios, C.A., O.M. Castellanos, and E.Casadiego-Guintero, 2017, Microstructural characterization of pore types in unconventional gas reservoirs utilizing FEG-SEM: An example from the Galembo member of the Cretaceous La Luna Formation, middle Magdalena Valley Basin (Colombia): Rev. Acad. Colomb. Cienc. Ex. Fis. Nat., v. 40(154), p. 161-175.

Rouzaud, J.-N., and A. Oberlin, 1990, The characterization of coals and cokes by transmission electron microscopy, in H. Charcosset, ed., Advanced methodologies in coal characterization: Elsevier, p. 311-355.

Ruble, T.E., K. Hooghan, W. Dorsey, W.R. Knowles, and C.D. Laughrey, 2017, Pore-scale imaging of solid bitumens: Insights for unconventional reservoir characterization: AAPG Search and Discovery Article #80580, 40 p. <http://www.searchanddiscovery.com/pdfz/documents/2017/80580ruble/ndx_ruble.pdf.html>

Ruhl, I.D., E. Salmon, and P.G. Hatcher, 2011, Early diagenesis of *Botryococcus braunii* race A as determined by high resolution magic angle spinning (HRMAS) NMR: Organic Geochemistry, v. 42, p. 1-14.

Ruppel, S.C., and R.G. Loucks, 2008, Black mudrocks: Lessons and questions from the Mississippian Barnett Shale in the southern Midcontinent: The Sedimentary Record, v. 6, no. 2, p. 4-8.

Ruppert, L.F., R. Sakurovs, T.P. Blach, L. He, Y.B. Melnichenko, D.F.R. Mildner, and L. Alcantar-Lopez, 2013, A USANS/SANS study of the accessibility of pores in the Barnett Shale to methane and water: Energy & Fuels, v. 27, p. 772-779.

Ruppert, L.F., and A.P. Radlinski, 2018, In honor of Dr., Yuri B. Melnichenko: Application of neutron scattering (SANS and USANS) to research on fossil fuel energy sources: International Journal of Coal Geology, v. 189, p. 68-69.

Saidian, M., U. Kuila, M. Prasad, S.R. Barraza, L.J. Godinez, and L. Alcantar-Lopez, 2016, A comparison of measurement techniques in shales (mudrocks): A case study of Haynesville, eastern European Silurian, Niobrara, and Monterey Formations, in T. Olson, ed., Imaging unconventional reservoir pore systems: AAPG Memoir 112, p. 89-144.

Saif, T., Q. Lin, B. Bijeljic, and M.J. Blunt, 2017, Microstructural imaging and characterization of oil shale before and after pyrolysis: Fuel, v. 197, p. 562-574.

Sanei, H., O. Haeri-Ardakani, J.M. Wood, and M E. Curtis, 2015, Effects of nanoporosity and surface imperfections on solid bitumen reflectance (Bro) measurements in unconventional reservoirs: International Journal of Coal Geology, v. 138, p. 95-102.

Sanei, H., and O.H. Ardakani, 2016, Alteration of organic matter by ion milling: International Journal of Coal Geology, v. 163, p. 123-131.

Saraji, S., and M. Piri, 2014, High-resolution three-dimensional characterization of pore networks in shale reservoir rocks: Unconventional Resources Technology Conference, URTeC 1870621, 17 p.

Saraji, S., and M. Piri, 2015, The representative sample size in shale oil rocks and nano-scale characterization of transport properties: International Journal of Coal Geology, v. 146, p. 42-54.

Schieber, J., 2010, Common themes in the formation and preservation of porosity in shales and mudstones: Illustrated with examples across the Phanerozoic: Society of Petroleum Engineers Unconventional Gas Conference, Pittsburgh, PA, SPE Paper 132370, 12 p.

Schieber, J., 2013, SEM observations on ion-milled samples of Devonian black shales from Indiana and New York: The petrographic context of multiple pore types, in W.K. Camp, E. Diaz, and B. Wawak, eds., Electron microscopy of shale hydrocarbon reservoirs: AAPG Memoir 102, p. 153-171.

Schieber, J., R. Lazar, K. Bohacs, R. Klimentidis, M. Dumitrescu, and J. Ottmann, 2016, An SEM study of porosity in the Eagle Ford Shale of Texas — Pore types and porosity distribution in a depositional and sequence-stratigraphic context: in J.A. Breyer, ed., The Eagle Ford Shale: A renaissance in U.S. oil production: AAPG Memoir 110, p. 167-186.

Scott, A.C., and M.E. Collinson, 1978, Organic sedimentary particles: results from scanning electron microscope studies of fragmentary plant material, in W.B. Whalley, ed., SEM in the study of sediments: Geoabstracts, Norwich, p. 137-167.

Shan, C., T. Zhang, J. Guo, Z. Zhang, and Y. Yang, 2015, Characterization of the micropore systems in high-rank coal reservoirs of the southern Sichuan Basin, China: AAPG Bulletin, v. 99, p. 2099-2119.

Shao, X., X. Pang, Q. Li, P. Wang, D. Chen, W. Shen, and Z. Zhao, 2017, Pore structure and fractal characteristics of organic-rich shales: A case study of the lower Silurian Longmaxi shales in the Sichuan Basin, SW China: Marine and Petroleum Geology, v. 80, p. 192-202.

Shao, X., X. Pang, H. Li, T. Hu, T. Xu, Y. Xu, and B. Li, 2018, Pore network characteristics of lacustrine shales in the Dongpu Depression, Bohai Bay Basin, China, with implications for oil retention: Marine and Petroleum Geology, v. 96, p. 457-473.

Shi, M., B. Yu, Z. Xue, J. Wu, and Y. Yuan, 2015, Pore characteristics of organic-rich shales with high thermal maturity: A case study of the Longmaxi gas shale reservoirs from well Yuye-1 in southeastern Chongqing, China: Journal of Natural Gas Science and Engineering, v. 26, p. 948-959.

Shi, M., B. Yu, J. Zhang, H. Huang, Y. Yuan, and B. Li, 2018, Microstructural characterization of pores in marine shales of the Lower Silurian Longmaxi Formation, southeastern Sichuan Basin, China: Marine and Petroleum Geology, v. 94, p. 166-178.

Shi, W., X. Wang, Z. Wang, Y. Shi, A. Feng, and N. Chen, 2020, A study on the relationship between graptolites and shale gas enrichment in the Wufeng-Longmaxi Formations of the Middle-Upper Yangtze region in China: Arabian Journal of Geosciences, v. 13: 483.

Shi, Y., M.R. Yassin, L. Yuan, and H. Dehghanpour, 2019, Modelling imbibition data for determining size distribution of organic and inorganic pores in unconventional rocks: International Journal of Coal Geology, v. 201, p. 26-43.

Slatt, R.M., and N.R. O’Brien, 2011, Pore types in the Barnett and Woodford gas shales: Contributions to understanding gas storage and migration pathways in fine-grained rocks: AAPG Bulletin, v. 95, p. 2017-2030.

Slatt, R.M., P.R. Philp, Y. Abousleiman, P. Singh, R. Perez, R. Portas, K.J. Marfurt, S. Madrid-Arroyo, N. O’Brien, E.V. Eslinger, and E.T. Baruch, 2012, Pore-to-regional-scale integrated characterization workflow for unconventional gas shales, in J. Breyer, ed., Shale reservoirs—Giant resources for the 21st century: AAPG Memoir 97, p. 127-150.

Slatt, R.M., N. O’Brien, C. Molinares-Blanco, A. Serna-Bernal, E. Torres, and P. Philp, 2013, Pores, spores, pollen and pellets: small, but significant constituents of resource shales: Unconventional Resources Technology Conference URTeC Control ID Number 1573336, 15 p.

Slatt, R.M., and N.R. O’Brien, 2013, Microfabrics related to porosity development, sedimentary and diagenetic processes, and composition of unconventional resource shale reservoirs as determined by conventional scanning electron microscopy, in W.K. Camp, E. Diaz, and B. Wawak, eds., Electron microscopy of shale hydrocarbon reservoirs: AAPG Memoir 102, p. 37-44.

Slatt, R.M., and N.R. O’Brien, 2014, Variations in shale pore types and their measurement: Unconventional Resources Technology Conference, URTeC 1921688, 7 p.

Słowakiewicz, M., E. Perri, and M.E. Tucker, 2016, Micro- and nanopores in tight Zechstein 2 carbonate facies from the southern Permian Basin, NW Europe: Journal of Petroleum Geology, v. 39, p. 149-168.

Sondergeld, C.H., K.E. Newsham, J.T. Comisky, M.C. Rice, and C.S. Rai, 2010, Petrophysical considerations in evaluating and producing shale gas resources: Society of Petroleum Engineers Unconventional Gas Conference, Pittsburgh, PA, SPE Paper 131768, 34 p.

Sondergeld, C.H., R.J. Ambrose, C.S. Rai, and J. Moncrieff, 2010, Micro-structural studies of gas shales: Society of Petroleum Engineers, SPE Paper 131771, 17 p.

Sondergeld, C.H., and C.S. Rai, 2010, Nanoscale imaging visualizes shale gas plays: Hart Energy Publishing, E&P, v. 83, no. 9, p. 51, 53.

Sondergeld, C.H., C.S. Rai, and M.E. Curtis, 2013, Microstructure and anisotropy in gas shales, in U. Hammes and J. Gale, eds., Geology of the Haynesville gas shale in east Texas and west Louisiana, U.S.A.: AAPG Memoir 105, p. 179-187.

Song, D., J. Tuo, C. Wu, M. Zhang, and L. Su, 2020, Comparison of pore evolution for a Mesoproterozoic marine shale and a Triassic terrestrial mudstone during artificial maturation experiments: Journal of Natural Gas Science and Engineering, v. 75, 103153.

Song, L., T. Warner, and T. Carr, 2019, An efficient, consistent, and trackable method to quantify organic matter-hosted porosity from ion-milled scanning electron microscope images of mudrock gas reservoirs: AAPG Bulletin, v. 103, p. 1473-1492.

Song, L., and T.R. Carr, 2020, The pore structural evolution of the Marcellus and Mahantango shales, Appalachian Basin: Marine and Petroleum Geology, v. 114, 104226.

Spain, D.R., and R. McLin, 2013, SEM characterization of shale gas reservoirs using combined secondary and backscatter electron methods: An example from the Haynesville Shale, Texas and Louisiana, in W.K. Camp, E. Diaz, and B. Wawak, eds., Electron microscopy of shale hydrocarbon reservoirs: AAPG Memoir 102, p. 45-52.

Stanton, R.W., and R.B. Finkelman, 1979, Petrographic analysis of bituminous coal: optical and SEM identification of constituents: Scanning Electron Microscopy, 1979, part 1, p. 465-471.

Stasiuk, L.D., 1999, Confocal laser scanning fluorescence microscopy of Botryococcus alginite from boghead oil shale, Boltysk, Ukraine: selective preservation of various micro-algal components: Organic Geochemistry, v. 30, p. 1021-1026.

Sun, M., B. Yu, Q. Hu, S. Chen, W. Xia, and R. Ye, 2016, Nanoscale pore characteristics of the Lower Cambrian Niutitang Formation shale: A case study from well Yuke #1 in the southeast of Chongqing, China: International Journal of Coal Geology, v. 154-155, p. 16-29.

Sun, M., B. Yu, Q. Hu, R. Yang, Y. Zhang, and B. Li, 2017, Pore connectivity and tracer migration of typical shales in south China: Fuel, v. 203, p. 32-46.

Sun, X., 2005, The investigation of chemical structure of coal macerals via transmitted-light FT-IR microspectroscopy: Spectrochimica Acta Part A, v. 62, p. 557-564.

Sun, Y., L. He, S. Kang, W. Guo, Q. Li, and S. Deng, 2018, Pore evolution of oil shale during sub-critical water extraction: Energies, v. 11, no. 4, 15 p.

Sutherland, J.K., 1975, Determination of organic sulphur in coal by microprobe: Fuel, v. 54, p. 132-134.

Tahmasebi, P., F. Javadpour, and M. Sahimi, 2016, Stochastic shale permeability matching: Three-dimensional characterization and modeling: International Journal of Coal Geology, v. 165, p. 231-242.

Tahmasebi, P., 2018, Nanoscale and multiresolution models for shale samples: Fuel, v. 217, p. 218-225.

Tahmasebi, P., F. Javadpour, and S.F. Enayati, 2020, Digital rock techniques to study shale permeability: A mini-review: Energy Fuels, v. 34, p. 15,672-15,685.

Tang, L., Y. Song, Z. Jiang, S. Jiang, and Q. Li, 2019, Pore structure and fractal characteristics of distinct thermally mature shales: Energy & Fuels, v. 33, p. 5116-5128.

Tang, X., J. Zhang, X. Wang, B. Yu, W. Ding, J. Xiong, Y. Yang, L. Wang, and C. Yang, 2014, Shale characteristics in the southeastern Ordos Basin, China: Implications for hydrocarbon accumulation conditions and the potential of continental shales: International Journal of Coal Geology, v. 128-129, p. 32-46. (clay rich; lacustrine)

Tang, X., Z. Jiang, S. Jiang, and Z. Li, 2016, Heterogeneous nanoporosity of the Silurian Longmaxi Formation shale gas reservoir in the Sichuan Basin using the QEMSCAN, FIB-SEM, and nano-CT methods: Marine and Petroleum Geology, v. 78, p. 99-109.

Tang, X., S. Jiang, Z. Jiang, Z. Li, Z. He, S. Long, and D. Zhu, 2019, Heterogeneity of Paleozoic Wufeng-Longmaxi formation shale and its effect on the shale gas accumulation in the Upper Yangtze region, China: Fuel, v. 239, p. 387-402.

Taylor, G.H., 1966, The electron microscopy of vitrinites, in R.F. Gould, ed., Coal science: American Chemical Society Advances in Chemistry Series 55, p. 274-283.

Taylor, G.H., M. Shibaoka, and S. Liu, 1981, Vitrinite macerals and coal utilization, in Proceedings, International Conference on Coal Science: Essen, Verlag Glückauf GmbH, p. 74-79. (TEM)

Taylor, G.H., S.Y. Liu, and M. Smyth, 1988, New light on the origin of Cooper Basin oil: APEA Journal, v. 28, part 1, p. 303-309. (TEM)

Taylor, G.H., 1991, Vitrinite reflectance and fine coal texture: University of Kentucky, Center for Applied Energy Research, Energeia, v. 2, no. 4, p. 1-3. (TEM)

Taylor, G.H., and M. Teichmüller, 1993, Observations of fluorinate and fluorescent vitrinite with the transmission electron microscope: International Journal of Coal Geology, v. 22, p. 61-82.

Tewari, A., S. Dutta, and T. Sarkar, 2016, Organic geochemical characterization and shale gas potential of the Permian Barren Measures Formation, west Bokaro sub-basin, eastern India: Journal of Petroleum Geology, v. 39, p. 49-60.

Tian, H., L. Pan, T. Zhang, X. Xiao, Z. Meng, and B. Huang, 2015, Pore characterization of organic-rich Lower Cambrian shales in Qinnan Depression of Guizhou Province, southwestern China: Marine and Petroleum Geology, v. 62, p. 28-43.

Topór, T., A. Derkowski, P. Ziemiański, J. Szczurowski, and D.K. McCarty, 2017, The effect of organic matter maturation and porosity evolution on methane storage potential in the Baltic Basin (Poland) shale-gas reservoir: International Journal of Coal Geology, v. 180, p. 46-56.

Uvarova, Y., A. Yurikov, M. Pervukhina, M. Lebedev, V. Shulakova, M.B. Clennell, and D.N. Dewhurst, 2014, Microstructural characterization of organic-rich shale before and after yrolysis: APPEA Journal 2014, p. 249-258.

Valentine, B.J., P.C. Hackley, J. Hatcherian, and J.-J. Yu, 2019, Reflectance increase from broad beam ion milling of coals and organic-rich shales due to increased surface flatness: International Journal of Coal Geology, v. 201, p. 86-101.

Van Geet, M., R. Sweenen, and P. David, 2001, Quantitative coal characterization by means of midrofocus x-ray computer tomography, colour image analysis and back-scattered scanning electron microscopy: International Journal of Coal Geology, v. 46, p. 11-25.

Vescogi, H., J. Sanchez-Ramirez, and J. Capsan, 2016, A case study of porosity deficit in digital rock measurements (abstract): Mudstone Diagenesis Conference, session 5, 2 p.

Vranjes-Wessely, S., D. Misch, I. Issa, D. Kiener, R. Fink, T. Seemann, B. Liu, G. Rantitsch, and R.F. Sachsenhofer, 2020, Nanoscale pore structure of Carboniferous coals from the Ukrainian Donets Basin: A combined HRTEM and gas sorption study: International Journal of Coal Geology, v. 224, 103484.

Walls, J.D., 2011, Digital rock physics provides new insight into shale reservoir quality: Hart Energy Publishing, E&P, v. 84, no. 8, p. 52-53.

Walters, C.C., C.E. Kliewer, D.N. Awwiller, M.D. Rudnicki, Q.R. Passey, and M.W. Lin, 2014, Influence of turbostratic carbon nanostructures on electrical conductivity in shales: International Journal of Coal Geology, v. 122, p. 105-109. (HRTEM)

Wang, F., and S. Guo, 2019, Influential factors and model of shale pore evolution: A case study of a continental shale from the Ordos Basin: Marine and Petroleum Geology, v. 102, p. 271-282.

Wang, F.P., and R.M. Reed, 2009, Pore networks and fluid flow in gas shales: Society of Petroleum Engineers, SPE Paper 124253, 8 p.

Wang, F.P., U. Hammes, R. Reed, T. Zhang, X. Tang, and Q. Li, 2013, Petrophysical and mechanical properties of organic-rich shales and their influences on fluid flow, in J. Chatellier and D. Jarvie, eds., Critical assessment of shale resource plays: AAPG Memoir 103, p. 167-186.

Wang, G., 2020, Deformation of organic matter and its effect on pores in mud rocks: AAPG Bulletin, v. 104, p. 21-36.

Wang, G., S. Long, Y. Peng, and Y. Ju, 2020, Characteristics of organic matter particles and organic pores of shale gas reservoirs: A case study of Longmaxi-Wufeng Shale, eastern Sichuan Basin: Minerals, v. 10, no. 2, 27 p.

Wang, L., and H. Cao, 2016, Probable mechanism of organic pores evolution in shale: Case study in Dalong Formation, Lower Yangtze area, China: Journal of Natural Gas Geoscience, v. 1, p. 295-298.

Wang, P., Z. Jiang, W. Ji, C. Zhang, Y. Yuan, L. Chen, and L. Yin, 2016, Heterogeneity of intergranular, intraparticle and organic pores in Longmaxi shale in Sichuan Basin, south China: Evidence from SEM digital images and fractal and multifractal geometries: Marine and Petroleum Geology, v. 72, p. 122-138.

Wang, P., Z. Jiang, L. Chen, L. Yin, Z. Li, C. Zhang, X. Tang, and G. Wang, 2016, Pore structure characterization for the Longmaxi and Niutitang shales in the Upper Yangtze Platform, south China: Evidence from focused ion beam—He ion microscopy, nano-computerized tomography and gas adsorption analysis: Marine and Petroleum Geology, v. 77, p. 1323-1337.

Wang, P., Z. Chen, Z. Jin, C. Jiang, M. Sun, Y. Guo, X. Chen, and Z. Jia, 2018, Shale oil and gas resources in organic pores of the Devonian Duvernay Shale, Western Canada Sedimentary Basin based on petroleum system modeling: Journal of Natural Gas Science and Engineering, v. 50, p. 33-42.

Wang, Q., H. Lu, T. Wang, D. Liu, P. Peng, X. Zhan, and X. Li, 2018, Pore characterization of Lower Silurian shale gas reservoirs in the Middle Yangtze region, central China: Marine and Petroleum Geology, v. 89, p. 14-26.

Wang, S., F. Javadpour, and Q. Feng, 2016, Molecular dynamics simulations of oil transport through inorganic nanopores in shale: Fuel, v. 171, p. 74-86.

Wang, X., Z. Jiang, K. Zhang, M. Wen, Z. Xue, W. Wu, Y. Huang, Q. Wang, X. Liu, T. Liu, and X. Xie, 2020, Analysis of gas composition and nitrogen sources of shale gas reservoir under strong tectonic events: Evidence from the Complex Tectonic Area in the Yangtze Plate: Energies, v. 13, 281, 17 p.

Wang, Y., J. Pu, L. Wang, J. Wang, Z. Jiang, Y.-F. Song, C.-C. Wang, Y. Wang, and C. Jin, 2016, Characterization of typical 3D pore networks of Jiulaodong Formation shale using nano-transmission X-ray microscopy: Fuel, v. 170, p. 84-91.

Wang, Y., Y. Zhu, S. Liu, and R. Zhang, 2016, Pore characterization and its impact on methane adsorption capacity for organic-rich marine shales: Fuel, v. 181, p. 227-237.

Wang, Y., Y. Qin, R. Zhang, L. He, L.M. Anovitz, M. Bleuel, D.F.R. Mildner, S. Liu, and Y. Zhu, 2018, Evaluation of nanoscale accessible pore structures for improved prediction of gas production potential in Chinese marine shales: Energy & Fuels, v. 32, p. 12447-12461.

Wang, Y., L. Liu, Q. Hu, L. Hao, X. Wang, and Y. Sheng, 2020, Nanoscale pore network evolution of Xiamaling marine shale during organic matter maturation by hydrous pyrolysis: Energy & Fuels, v. 34, p. 1548-1563.

Wang, Y., S. Xu, F. Hao, B. Zhang, Z. Shu, Q. Gou, Y. Lu, and F. Cong, 2020, Multiscale petrographic heterogeneity and their implications for the nanoporous system of the Wufeng-Longmaxi shales in Jiaoshiba area, southeast China: Response to depositional-diagenetic process: Geological Society of America Bulletin, v. 132, p. 1704-1721.

Ward, C.R., and L.W. Gurba, 1998, Occurrence and distribution of organic sulphur in macerals of Australian coals using electron microprobe techniques: Organic Geochemistry, v. 28, p. 635-647.

Ward, C.R., and L.W. Gurba, 1999, Chemical composition of macerals in bituminous coals of the Gunnedah Basin, Australia, using electron microprobe analysis techniques: International Journal of Coal Geology, v. 39, p. 279-300.

Ward, C.R., Z. Li, and L.W. Gurba, 2005, Variations in coal maceral chemistry with rank advance in the German Creek and Moranbah coal measures of the Bowen Basin, Australia, using electron microprobe techniques: International Journal of Coal Geology, v. 63, p. 117-129.

Ward, C.R., Z. Li, and L.W. Gurba, 2008, Comparison of elemental composition of macerals determined by electron microprobe to whole-coal ultimate analysis data: International Journal of Coal Geology, v. 75, p. 157-165.

Ward, C.R., Z. Li, and L.W. Gurba, 2005, Variations in coal maceral chemistry with rank advance in the German Creek and Moranbah coal measures of the Bowen Basin, Australia, using electron microprobe techniques: International Journal of Coal Geology, v. 63, p. 117-129.

Wei, M., L. Zhang, Y. Xiong, and P. Peng, 2019, Main factors influencing the development of nanopores in over-mature, organic-rich shales: International Journal of Coal Geology, v. 212, 103233.

Wei, S., S. He, Z. Pan, G. Zhai, T. Dong, X. Guo, R. Yang, Y. Han, and W. Yang, 2020, Characteristics and evolution of pyrobitumen-hosted pores of the overmature Lower Cambrian Shuijingtuo Shale in the south of Huangling anticline, Yichang area, China: Evidence from FE-SEM petrography: Marine and Petroleum Geology, v. 116, 104303.

Wei, Z., Y. Wang, G. Wang, Z. Sun, and L. Xu, 2018, Pore characterization of organic-rich Late Permian Da-long Formation shale in the Sichuan Basin, southwestern China: Fuel, v. 211, p. 507-516.

Wilson, R.D., J. Chitale, K. Huffman, P. Montgomery, and S.J. Prochnow, 2020, Evaluating the depositional environment, lithofacies variation, and diagenetic processes of the Wolfcamp B and lower Spraberry intervals in the Midland Basin: Implications for reservoir quality and distribution: AAPG Bulletin, v. 104, p. 1287-1321.

Wood, J.M., H. Sanei, M.E. Curtis, and C.R. Clarkson, 2015, Solid bitumen as a determinant of reservoir quality in an unconventional tight gas siltstone play: International Journal of Coal Geology, v. 150-151, p. 287-295.

Wood, J.M., H. Sanei, O. Haeri-Ardakani, M.E. Curtis, T. Akai, and C. Currie, 2018, Solid bitumen in the Montney Formation: Diagnostic petrographic characteristics and significance for hydrocarbon migration: International Journal of Coal Geology, v. 198, p. 48-62.

Wood, J.M., O. Haeri-Ardakani, H. Sanei, M.E. Curtis, and D. Royer, 2020, Application of paleoporosity and bitumen saturation concepts to tight-gas accumulations containing solid bitumen: International Journal of Coal Geology, v. 228, 103547.

Wu, J., Y. Yuan, S. Niu, X. Wei, and J. Yang, 2020, Multiscale characterization of pore structure and connectivity of Wufeng-Longmaxi shale in Sichuan Basin, China: Marine and Petroleum Geology, v. 120, 104514.

Wu, L., Y. Lu, S. Jiang, Y. Lu, X. Liu, and H. Hu, 2018, Pore structure characterization of different lithologies in marine shale: A case study of the Upper Ordovician Wufeng-Lower Silurian Longmaxi formation in the Sichuan Basin, SW China: Journal of Natural Gas Science and Engineering, v. 57, p. 203-215.

Wu, S., R. Zhu, J. Cui, B. Bai, X. Zhang, X. Jin, D. Zhu, J. You, and X. Li, 2015, Characteristics of shale porosity evolution, Triassic Chang 7 member, Ordos Basin, NW China: Petroleum Exploration and Development, v. 42, p. 185-195.

Wu, Y., P. Tahmasebi, C. Lin, and C. Dong, 2020, Process-based and dynamic 2D modeling of shale samples: Considering the geology and pore-system evolution: International Journal of Coal Geology, v. 218, 103368.

Wu, Y., P. Tahmasebi, C. Lin, and C. Dong, 2020, A comprehensive investigation of the effects of organic-matter pores on shale properties: A multicomponent and multiscale modeling: Journal of Natural Gas Science and Engineering, v. 81, 103425.

Wüst, R.A.J., B.R. Nassichuk, and R.M. Bustin, 2013, Porosity characterization of various organic-rich shales from the Western Canadian Sedimentary Basin, Alberta and British Columbia, Canada, in W.K. Camp, E. Diaz, and B. Wawak, eds., Electron microscopy of shale hydrocarbon reservoirs: AAPG Memoir 102, p. 81-100.

Xhao, X., Q. Li, X. Jiang, R. Zhang, and H. Li, 2014, Organic geochemistry and reservoir characterization of the organic matter-rich calcilutite in the Shulu Sag, Bohai Bay Basin, north China: Marine and Petroleum Geology, v. 51, p. 239-255.

Xi, Z., S. Tang, J. Wang, G. Yang, and L. Li, 2018, Formation and development of pore structure in marine-continental transitional shale from northern China across a maturation gradient: insights from gas adsorption and mercury intrusion: International Journal of Coal Geology, v. 200, p. 87-102.

Xi, Z., S. Tang, J. Li, Z. Zhang, and H. Xiao, 2019, Pore characterization and the controls of organic matter and quartz on pore structure: Case study of the Niutitang Formation of northern Guizhou Province, south China: Journal of Natural Gas Science and Engineering, v. 61, p. 18-31.

Xin, F., H. Xu, D. Tang, J. Yang, Y. Chen, L. Cao, and H. Qu, 2019, Pore structure evolution of low-rank coal in China: International Journal of Coal Geology, v. 205, p. 126-139.

Xu, H., W. Zhou, R. Zhang, S. Liu, and Q. Zhou, 2019, Characterizations of pore, mineral and petrographic properties of marine shale using multiple techniques and their implications on gas storage capability for Sichuan Longmaxi gas shale field in China: Fuel, v. 241, p. 360-371.

Xu, J., and S.A. Sonnenberg, 2017, An SEM study of porosity in the organic-rich Lower Bakken member and Pronghorn member, Bakken Formation, Williston Basin: Unconventional Resources Technology Conference, URTeC 2697215, 13 p. <http://archives.datapages.com/data/urtec/2017/2697215.html>

Xu, S., Q. Gou, F. Hao, B. Zhang, Z. Shu, Y. Lu, and Y. Wang, 2020, Shale pore structure characteristics of the high and low productivity wells, Jiaoshiba shale gas field, Sichuan Basin, China: Dominated by lithofacies or preservation condition? Marine and Petroleum Geology, v. 114, 104211.

Xu, Z., W. Shi, G. Zhai, N. Peng, and C. Zhang, 2020, Study on the characterization of pore structure and main controlling factors of pore development in gas shale: Journal of Natural Gas Geoscience, v. 5, p. 255-271.

Xue, C., J. Wu, L. Qiu, Y. Liu, and J. Zhong, 2020, Effect of thermal maturity on pore type and size in transitional shale reservoirs: An example from the Upper Paleozoic Shanxi Formation, Ordos Basin, China: Energy Fuels, v. 34, p. 15,736-15,751.

Yan, J.-F., Y.-P. Men, Y.-Y. Sun, Q. Yu, W. Liu, H.-Q. Zhang, J. Liu, J.-W. Kang, S.-N. Zhang, H.-H. Bai, and X. Zheng, 2016, Geochemical and geological characteristics of the Lower Cambrian shales in the middle-upper Yangtze area of south China and their implication for the shale gas exploration: Marine and Petroleum Geology, v. 70, p. 1-13.

Yang, C., W. Huang, B. Xiao, Z. Yu, P. Peng, J. Fu, and G. Sheng, 2004, Intercorrelations among degree of geochemical alterations, physicochemical properties, and organic sorption equilibria of kerogen: Environmental Science & Technology, v. 38, p. 4396-4408. (SEM)

Yang, C., J. Zhang, S. Han, B. Xue, and Q. Zhao, 2016, Classification and the development regularity of organic-associated pores (OAP) through a comparative study of marine, transitional, and terrestrial shales in China: Journal of Natural Gas Science and Engineering, v. 36, p. 358-368.

Yang, C., J. Zhang, X. Tang, J. Ding, Q. Zhao, W. Dang, H. Chen, Y. Su, B. Li, and D. Lu, 2017, Comparative study on micro-pore structure of marine, terrestrial, and transitional shales in key areas, China: International Journal of Coal Geology, v. 171, p. 76-92.

Yang, C., Y. Xiong, J. Zhang, Y. Liu, and C. Chen, 2019, Comprehensive understanding of OM-hosted pores in transicional shale: A case study of Permian Longtan Shale in south China based on organic petrographic analysis, gas adsorption, and X-ray diffraction measurements: Energy & Fuels, v. 33, p. 8055-8064.

Yang, C., Y. Xiong, and J. Zhang, 2020, A comprehensive re-understanding of the OM-hosted nanopores in the marine Wufeng-Longmaxi shale formation in south China by organic petrology, gas adsorption, and X-ray diffraction studies: International Journal of Coal Geology, v. 218, 103362.

Yang, F., Z. Ning, Q. Wang, and H. Liu, 2016, Pore structure of Cambrian shales from the Sichuan Basin in China and implications to gas storage: Marine and Petroleum Geology, v. 70, p. 14-26.

Yang, F., Z. Ning, Q. Wang, R. Zhang, and B.M. Krooss, 2016, Pore structure characteristics of lower Silurian shales in the southern Sichuan Basin, China: Insights to pore development and gas storage mechanism: International Journal of Coal Geology, v. 156, p. 12-24.

Yang, J., J. Hatcherian, P.C. Hackley, and A.E. Pomerantz, 2017, Nanoscale geochemical and geomechanical characterization of organic matter in shale: Nature Communications, v. 8: 2179, 9 p.

Yang, R., S. He, J. Yi, and Q. Hu, 2016, Nano-scale pore structure and fractal dimension of organic-rich Wufeng-Longmaxi shale from Jiaoshiba area, Sichuan Basin: Investigations using FE-SEM, gas adsorption and helium pycnometry: Marine and Petroleum Geology, v. 70, p. 27-45.

Yang, W., S. He, G. Zhai, T. Dong, D. Gong, X. Yuan, and S. Wei, 2019, Shale-gas accumulation and pore structure characteristics in the lower Cambrian Niutitang shales, Cen-gong Block, south China: Australian Journal of Earth Sciences, v. 66, no. 2, p. 289-303.

Yang, Y., and F. Bao, 2017, Characteristics of shale nanopore system and its internal gas flow: A case study of the lower Silurian Longmaxi Formation shale from Sichuan Basin, China: Journal of Natural Gas Geoscience, v. 2, p. 303-311.

Yao, Y., D. Liu, Y. Che, D. Tang, S. Tang, and W. Huang, 2010, Petrophysical characterization of coals by low-field nuclear magnetic resonance (NMR): Fuel, v. 89, p. 1371-1380.

Yi, J., H. Bao, A. Zheng, B. Zhang, Z. Shu, J. Li, and C. Wang, 2019, Main factors controlling marine shale gas enrichment and high-yield wells in South China: A case study of the Fuling shale gas field: Marine and Petroleum Geology, v. 103, p. 114-125.

Zagorski, W.A., M. Emery, and D.C. Bowman, 2011, Factors control Marcellus productivity: American Oil & Gas Reporter, v. 54, no. 8, p. 172-180.

Zargari, S., K.L. Canter, and M. Prasad, 2015, Porosity evolution in oil-prone source rocks: Fuel, v. 153, p. 110-117. [organic porosity in oil window is filled with/blocked by bitumen]

Zeng, J., W. Jia, P. Peng, C. Guan, C. Zhou, X. Yuan, S. Chen, and C. Yu, 2016, Composition and pore characteristics of black shales from the Ediacaran Lantian Formation in the Yangtze Block, south China: Marine and Petroleum Geology, v. 76, p. 246-261.

Zhang, J., X. Li, Q. Wei, W. Gao, W. Liang, Z. Wang, and F. Wang, 2017, Quantitative characterization of pore-fracture system of organic-rich marine-continental shale reservoirs: A case study of the Upper Permian Longtan Formation, southern Sichuan Basin, China: Fuel, v. 200, p. 272-281.

Zhang, J.., X. Li, Z. Xiaoyan, G. Zhao, B. Zhou, J. Li, Z. Xie, and F. Wang, 2019, Characterization of the full-sized pore structure of coal-bearing shales and its effect on shale gas content: Energy & Fuels, v. 33, p. 1969-1982.

Zhang, L., Z. Chen, Z. Li, S. Zhang, J. Li, Q. Liu, R. Zhu, J. Zhang, and Y. Bao, 2019, Structural features and genesis of microscopic pores in lacustrine shale in an oil window: A case study of the Dongying depression: AAPG Bulletin, v. 103, p. 1889-1924.

Zhang, P., S. Lu, J. Li, H. Xue, W. Li, and P. Zhang, 2017, Characterization of shale pore system: A case study of Paleogene Xin’gouzui Formation in the Jianghan Basin, China: Marine and Petroleum Geology, v. 79, p. 321-334.

Zhang, P., S. Lu, and J. Li, 2019, Characterization of pore size distributions of shale oil reservoirs: A case study from Dongying sag, Bohai Bay Basin, China: Marine and Petroleum Geology, v. 100, p. 297-308.

Zhang, Q., R. Liu, Z. Pang, W. Lin, W. Bai, and H. Wang, 2016, Characterization of microscopic pore structures in Lower Silurian black shale(S11), southeastern Chongqing, China: Marine and Petroleum Geology, v. 71, p. 250-259.

Zhang, Q., Z. Pang, J. Zhang, W. Lin, and S. Jiang, 2017, Qualitative and quantitative characterization of a transitional shale reservoir: A case study from the Upper Carboniferous Taiyuan shale in the eastern uplift of Liaohe Depression, China: Marine and Petroleum Geology, v. 80, p. 307-320.

Zhang, S., L. Canter, and M. Sonnenfeld, 2017, Capillary fluid dynamics within unconventional rocks investigated by scanning electron microscopy: AAPG Bulletin, v. 101, p. 1759-1765.

Zhang, S., J. Yan, Q. Hu, J. Wang, T. Tian, J. Chao, and M. Wang, 2019, Integrated NMR and FE-SEM methods for pore structure characterization of Shahejie shale from the Dongying Depression, Bohai Bay Basin: Marine and Petroleum Geology, v. 100, p. 85-94.

Zhang, T., Y. He, Y. Yang, and K. Wu, 2017, Molecular simulation of shale gas adsorption in organic-matter nanopore: Journal of Natural Gas Geoscience, v. 2, p. 323-332.

Zhang, W., and Q. Wang, 2018, Permeability anisotropy and gas slippage of shales from the Sichuan Basin in South China: International Journal of Coal Geology, v. 194, p. 22-32.

Zhang, W., W. Hu, T. Borjigin, and F. Zhu, 2020, Pore characteristics of different organic matter in black shale: A case study of the Wufeng-Longmaxi Formation in the southeast Sichuan Basin, China: Marine and Petroleum Geology, v. 111, p. 33-43.

Zhang, Y., R.G. Moghanloo, and D. Davudov, 2019, Pore structure characterization of a shale sample using SEM images: Society of Petroleum Engineers, Western Regional Meeting, SPE-195352-MS, 13 p.

Zhang, Y., B.Yu, Z. Pan, C. Hou, Q. Zuo, and M. Sun, in press, Effect of thermal maturity on shale pore structure: a combined study using extracted organic matter and bulk shale from Sichuan Basin, China: Journal of Natural Gas Science and Engineering. <https://www.sciencedirect.com/science/article/pii/S1875510019303415?via%3Dihub>

Zhang, Y., T.J. Barber, Q. Hu, M. Bleuel, and H.F. El-Sobky, 2019, Complementary neutron scattering, mercury intrusion and SEM imaging approaches to micro- and nano-pore structure characterization of tight rocks: A case study of the Bakken shale: International Journal of Coal Geology, v. 212, 103252.

Zhao, J., Z. Jin, Z. Jin, Q. Hu, Z. Hu, W. Du, C. Yan, and Y. Geng, 2017, Mineral types and organic matters of the Ordovician-Silurian Wufeng and Longmaxi Shale in the Sichuan Basin, China: Implications for pore systems, diagenetic pathways, and reservoir quality in fine-grained sedimentary rocks: Marine and Petroleum Geology, v. 86, p. 655-674.

Zhao, P., Z. Wang, Z. Sun, J. Cai, and L. Wang, 2017, Investigation on the pore structure and multifractal characteristics of tight oil reservoirs using NMR measurements: Permian Lucaogou Formation in Jimusaer Sag, Junggar Basin: Marine and Petroleum Geology, v. 86, p. 1067-1081.

Zhao, S., Y. Li, Y. Wang, Z. Ma, and X. Huang, 2019, Quantitative study on coal and shale pore structure and surface roughness based on atomic force microscopy and image processing: Fuel, v. 244, p. 78-90.

Zhao, X., Q. Li, Z. Jiang, R. Zhang, and H. Li, 2014, Organic geochemistry and reservoir characterization of the organic matter-rich calcilutite in the Shulu Sag, Bohai Bay Basin, North China: Marine and Petroleum Geology, v. 51, p. 239-255.

Zheng, X., B. Zhang, H. Sanei, H. Bao, Z. Meng, C. Wang, and K. Li, 2019, Pore structure characteristics and its effect on shale gas adsorption and desorption behavior: Marine and Petroleum Geology, v. 100, p. 165-178.

Zheng, Y., Y. Liao, Y. Wang, Y. Xiog, and P. Peng, 2018, Organic geochemical characteristics, mineralogy, petrophysical properties, and shale gas prospects of the Wufeng-Longmaxi shales in Sanquan Town of the Nanchuan District, Chongqing: AAPG Bulletin, v. 102, p. 2239-2265.

Zhou, S., G. Yan, H. Xue, W. Guo, and X. Li, 2016, 2D and 3D nanopore characterization of gas shale in Longmaxi formation based on FIB-SEM: Marine and Petroleum Geology, v. 73, p. 174-180.

Zhou, S., D. Liu, Y. Cai, Y. Yao, and Z. Li, 2017, 3D characterization and quantitative evaluation of pore-fracture networks of two Chinese coals using FIB-SEM tomography: International Journal of Coal Geology, v. 174, p. 41-54.

Zhou, S., D. Yan, J. Tang, and Z. Pan, 2020, Abrupt change of pore system in lacustrine shales at oil- and gas-maturity during catagenesis: International Journal of Coal Geology, v. 228, 103557.

Zhu, H., Y. Ju, Y. Qi, C. Huang, and L. Zhang, 2018, Impact of tectonism on pore type and pore structure evolution in organic-rich shale: Implications for gas storage and migration pathways in naturally deformed rocks: Fuel, v. 228, p. 272-289.

Zhu, H., Y. Ju, C. Huang, Y. Qi, L. Ju, K. Yu, W. Li, H. Feng, and P. Qiao, 2019, Petrophysical properties of the major marine shales in the Upper Yangtze Block, south China: A function of structural deformation: Marine and Petroleum Geology, v. 110, p. 768-786.

Zhu, H., Y. Ju, C. Huang, K. Han, Y. Qi, M. Shi, K. Yu, H. Feng, W. Li, L. Ju, and J. Qian, 2019, Pore structure variations across structural deformation of Silurian Longmaxi Shale: An example from the Chuandong Thrust-Fold Belt: Fuel, v. 241, p. 914-932.

Zhu, X., J. Cai, G. Wang, and M. Song, 2018, Role of organo-clay composites in hydrocarbon generation of shale: International Journal of Coal Geology, v. 192, p. 83-90.

Zippi, P.A., 1991, SEM and light microscope mounting and specimen location technique for same-specimen study of palynological strew mounts: Micropaleontology, v. 37, no. 4, p. 407-413.

Zodrow, E.L., and M. Mastalerz, 2002, FTIR and py-GC-MS spectra of true-fern and seed-fern spenopterids (Sydney coalfield, Nova Scotia, Canada, Pennsylvanian): International Journal of Coal Geology, v. 51, p. 111-127.

Zodrow, E.L., M. Mastalerz, and Z. Simunek, 2003, FTIR-derived characteristics of fossil-gymnosperm leaf remains of Cordaites principalis and Cordaites borassifolius (Pennsylvanian, Maritimes Canada and Czech Republic): International Journal of Coal Geology, v. 55, p. 95-102.

Zodrow, E.L., and M. Mastalerz, 2007, Functional groups in a single pteridosperm species: Variability and circumscription (Pennsylvanian, Nova Scotia, Canada): International Journal of Coal Geology, v. 70, p. 313-324.

Zou, J., W. Chen, D. Yang, J. Yuan, and Y.-Y. Jiao, 2019, Fractal characteristics of the anisotropic microstructure and pore distribution of low-rank coal: AAPG Bulletin, v. 103, p. 1297-1319.