

BASIN ANALYSIS AND SEQUENCE STRATIGRAPHY TECHNICAL DIVISION

How to Use Microscopic Fossils to Find and Produce Oil and Gas

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ABSTRACT

Biostratigraphy is a fundamental oilfield service which is based on the analysis of microscopic fossils. Demand for this service is global; for example, it is a standard requirement on almost all offshore exploration wells. However, the use of oilfield paleontology has waned in Canada, largely due to a lack of investment, retirement of specialists, and lowered interest in industrial and academic research institutes.

Oilfield paleontology commonly involves three paleontological disciplines, each conducted by a relevant specialist: 1) Micropaleontology [foraminifera, ostracods, radiolaria, diatoms, conodonts, etc.]; 2) Nannopaleontology [calcareous nannofossils]; and 3) Palynology [spores, pollen, dinoflagellate cysts, acritarchs, and other organic walled fossils]. Each discipline has unique advantages and challenges, and it is important to select the best and most effective discipline(s) for any given geological scenario. The frequency of cuttings samples, availability of core or sidewall cores, and even the drilling technique applied can all have a bearing on acquisition of biostratigraphic data. Sample processing needs to be tailored to particular fossil groups. The processing and identification of fossils can be done on the rig in real-time, or later in the office.

Current standard applications include dating of the sediments, correlation with surrounding wells using biostratigraphy, and the modeling of depositional environments. On rig interpretation (especially for costly offshore wells) is commonly used to assist with key stratigraphic picks for casing, coring and TD determinations, all of which may be safety critical, and “biosteering” horizontal wells. Biostratigraphic data can also be integrated with sequence stratigraphic models, supporting basin analysis and the confident correlation of seismic horizons. Palynology has some other key applications including source rock analysis, thermal maturation (along with conodonts), non-marine stratigraphy, palynofacies construction, and paleoclimate resolution. The fossils used are so small that it is often possible to find hundreds (or even thousands) of specimens in one sample, and statistical analysis of quantitative datasets assists model generation and paleoenvironmental interpretations.

As outlined above, paleontology has many value-adds to exploration and production geoscientists. Recent developments include the application of automatic fossil identification using Artificial Intelligence, machine colour recognition for thermal maturation, and integration with isotopic/elemental stratigraphy studies. Future directions in palynology could include genome analysis and bacterial spore stratigraphy. The study of organic and inorganic microfossils will continue to be a great value add to petroleum exploration and production. This presentation aims to highlight some of the applications of this fundamental but sometimes forgotten science.



BIOGRAPHY:

Dr. Kimberley Bell's technical expertise in Mesozoic and Paleogene palynology and stratigraphy spans Northern and Western Canada. Her research has focused on the biostratigraphy and paleoenvironmental interpretations of numerous Yukon basins, the District of Mackenzie in the Northwest Territories, southwest British Columbia, and the Arctic Islands. Kimberley has a special interest in angiosperm pollen evolution using stratigraphic sections throughout Alberta, Saskatchewan, Montana, Yukon and Northwest Territories. She's also worked with palynological data from the Alberta Oilsands, creating an integrated paleoclimate model for deposition of the McMurray Formation. Kimberley is also interested in using palynology to identify sedimentary recycling and as a tool for unraveling tectonic history.

Kimberley completed her Ph.D. at the University of Calgary in April 2018, with her dissertation focused on the biostratigraphy of Cretaceous and Paleogene strata from Yukon and Northwest Territories. She joined PetroStrat Ltd. with the opening of their first Canadian office in September 2020, following more than ten years' experience in palynology and biostratigraphy with the Geological Survey of Canada.

