Coccolith Studies in the Lower Jurassic of Alberta - A New Tool for Correlations of the Fernie Formation

CRAIG, JAMES H., Consultant, Bragg Creek, AB; C. L. RIEDIGER, The University of Calgary, Calgary, AB; and T. P. POULTON, Geological Survey of Canada, Calgary, AB

New discoveries of coccoliths (calcareous nanofossils) in the Lower Jurassic parts of the Fernie Formation of Alberta are important for resolving previously problematic dating and correlation problems of hydrocarbon-generating units. The historical questions of correlation and age derive from a general lack of diagnostic fossils in most areas. All of the coccolith species recognized have been recorded previously in Europe and the ages provided are consistent with stratigraphic interpretations in Alberta.

Two assemblages have been recognized in northern and western Alberta. The lower assemblage is well represented in plaly limestones in the subsurface that have traditionally been assigned to the Nordegg Member of the Fernie Formation, but which have recently been re-assigned to the Red Deer Member based on their lithology and age. Many of these 16 species have long ranges in Europe, but their overlap interval suggests correlation with the boundary between the early and late parts of the Pliensbachian stage. These Pliensbachian ages confirm previous dates for the plaly limestone unit derived from poorly preserved aachthopleuroceras.[7] ammonites. Some of the coccolith species, also occur in the uppermost beds of the Red Deer Member in outcrop at its type area in southwestern Alberta, which contains Late Pliensbachian ammonites.

Coccoliths from the Poker Chip Shale Member outcropping in southeastern British Columbia and southwestern Alberta are consistent with the Early Toarcian ages indicated by a variety of ammonite species in this unit. Middle and Upper Jurassic units of the Fernie also contain coccoliths which have potential to resolve problems in their correlation. The correlations, ages, and depositional relationships of the Nordegg chert and limestone member (carbonate platform) in central Alberta, and of the basal plaly limestone in northern Alberta (Red Deer Member, at least in part) have been shown to be problematic in recent years, and alternative interpretations appear in recent literature. The latter unit is rich in organic material and is a significant generator of oil and gas in the Western Canada Sedimentary Basin. A highly radioactive shale at its base appears to be continuous southward, where it lies at the base of the Nordegg carbonate platform. Thus, the Nordegg chert unit may be equivalent with the basal limestone to the north and is perhaps Pliensbachian age, rather than Sinemurian as is generally thought. This has implications for the relationship of the two units in western central Alberta as well, where the Red Deer Member has been interpreted, but not observed, to overlie the Nordegg.

Petroleum System Definition and Source Rock Deposition in the Western Canada Sedimentary Basin.

CREANEY, STEPHEN*, Exxon Exploration Company, Houston, TX, and JAMES ALLAN, (Deceased)

The Western Canada Basin (WCB) contains in excess of 10 oil prone, marine source rocks ranging in age from Middle Devonian to Late Cretaceous. In general the Palaeozoic sources were deposited in carbonate depositional environments and those of the Mesozoic were deposited in clastic dominated systems. Geochemical Biomarkers from oils and sources reflect this abrupt change as well as progressive changes related to source rock age.

All source rocks in the WCB can be demonstrated to have been effective and therefore 10+ Petroleum Systems co-exist within the sedimentary section. The WCB is very ‘laminated’, from a migration point of view with little mixing of oils from different systems. The Early Cretaceous Mannville section, positioned across the penepalined pre-Mannville surface, is an extremely significant exception and has acted as a regional ‘drain’ for any oil leaking from the pre-Cretaceous systems. This ‘leaking’ oil (dominantly from the Jurassic Nordegg and Mississippian Exshaw sources) was collected over an enormous drainage area and resulted in the approximately 1.7 trillion barrels of heavy oil in eastern Alberta. Using published in-place oil reserve numbers this represents 98% of the total oil in the basin, a testament to the lateral migration efficiency of this ‘supercharged, low impedance’ basin. The Joli Fou shale separates the Mannville ‘drain’ and older systems from the Late Cretaceous systems (Base of Fish, Second and First White Specks sources). No oil mixing across this relatively thin shale has been observed.

Overmature gas in the deep basin may have migrated cross stratially but lateral migration is the dominant migration style in the WCB with distances of up to 600Km observed. Biogenic methane in eastern Alberta may have filled traps early in that area and facilitated extremely long distance oil migration into Saskatchewan.