AAPG Datapages/Search and Discovery Article #90174 CSPG©2014 CSPG/CSEG/CWLS GeoConvention 2012, (Vision) May 14-18, 2012, Calgary, AB, Canada

Chemostratigraphic correlation and early phosphogenesis of carbonate (oil-) shale beds in the Green River Formation, Utah

Dave Keighley, Department of Earth Sciences, University of New Brunswick, Fredericton, NB., E3B 5A3
keig@unb.ca

The Green River Formation (GRF) of the Uinta Basin in eastern Utah contains part of the world's largest oil-shale deposit, primarily in the Mahogany Oil Shale Zone (MOSZ), and significant conventional oil and gas reserves in interfingering sandbodies that grade into the laterally equivalent Colton and Wasatch Formations. However, very few marker beds and intervals can be correlated across the Basin to help subdivide the 200 - 300 m-thick succession of oil shale, sodic-evaporitic shale, and carbonate mudstone-shale that comprises the MOSZ and upper GRF. By way of ICP (-MS), SEM, and XRD analyses of samples taken from three logged sections, at Cowboy Canyon, Buck Canyon (35 km to the southwest) and Gate Canyon (a further 80 km west), an attempt has been made to produce a chemostratigraphic correlation of the upper GRF.

Amongst several of the chemostratigraphic correlations proposed is the presence of several anomalously high phosphorus and rare-earth elements (REEs) readings, most of which are associated with a few of the numerous calcareous and dolomitic oil-shale beds. In particular, one bed encountered in both Cowboy and Buck, contains ~6.0 wt % P_2O_5, along with a gradual enrichment pattern, relative to the global PAAS standard, of the light to heavy REEs (other oil-shale beds in Buck and Gate have different and unique REE patterns). Phosphogenesis is interpreted to be the result of the formation, just below the sediment-water interface, of diagenetic microcrystalline calcium fluorapatite (CFA). The CFA fills pores and also fossilizes what are considered to be substrate coccoid bacteria. The CFA is concentrated in calcareous laminae that display evidence of having slumped. These laminae contain oblate ~10μm diameter low-Mg calcite grains that often display a central cavity and are of uncertain origin. Calcite cements are also present that postdate variably ferroan dolomite rhombs and probably also the CFA. The likely abundance of dissolved Ca (and Na), and thus probable alkaline porewater conditions during initial burial, renders unnecessary the presence of an oft-cited precursor iron oxide crust. Since dissolved porewater P is considered to diffuse back up into the water column under anoxic conditions the dogma is that P would never reach saturation unless first trapped by adsorption to Fe-oxyhydroxides forming a thin crust on the sediment under oxic conditions. However, calcite itself could act to trap the phosphorus, sorption capacities for Fe-oxides decrease as pH levels increase above 6.5, and a stratified water column in a saline lake might itself allow for the concentration to supersaturation of P in bottom waters at the sediment interface.