

Spectral gamma ray characterization of high resolution sequence stratigraphy: examples from Upper Carboniferous fluvio-deltaic systems, County Clare, Ireland

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Geological Society, London, Special Publications 1996, v. 104, p. 25-35

<http://sp.lyellcollection.org/content/104/1/25.abstract?sid=49789403-ec58-42ef-ba71-759cb4cad736>

Abstract:

The application of high resolution sequence stratigraphy requires the ability to recognize key surfaces which record fluctuations in relative sea-level. In sub-surface studies, gamma ray logs have been used to identify maximum flooding surfaces, but their full potential has not been realized. Gamma ray profiles produced using a portable spectrometer on exposed Upper Carboniferous fluvio-deltaic deposits in western Ireland reveal that key surfaces and systems tracts can be characterized more comprehensively and recognized with greater confidence if spectral gamma ray data (K, U, Th and their respective

ratios) are used in conjunction with traditional total count data. Maximum flooding surfaces can be distinguished from lesser flooding surfaces by a distinctive U peak (> 5 ppm) and low Th/U ratio (< 2.5). Erosional unconformities and their associated incised valley fills are characterized by consistently low total counts (40–50 cps) and high Th/K ratios (> 6). Laterally correlative interfluves are represented by distinctive palaeosols that can be clearly identified in spectral gamma ray data by their anomalously low K content (<0.4%) and exceptionally high Th/K ratio (> 17). Finally, the stacking pattern of parasequence sets can be identified using the trends of Th/K ratios from sandstones in successive parasequences. These results have widespread implications for the recognition of high resolution sequence stratigraphic signatures in the stratigraphic record, with particular reference to the subsurface analysis of fluvio-deltaic deposits.