Chemostratigraphy as a correlation tool in fluvial depositional settings

K.T. Ratcliffe (Chemostrat Consultants)*,

T.J. Pearce and J. Martin (Chemostrat Consultants)

In broad terms, the technique of chemostratigraphy encompasses the study of the inorganic geochemistry of sedimentary sequences. In more practical terms, it is a technique that uses variations in the geochemistry of sediments as a correlation tool. For the petroleum industry, analyses of cuttings samples, conventional core samples, sidewall cores or outcrop samples allows regional to reservoir-scale interwell correlations to be made. In addition to the correlation of sequences, the geochemical data can be used in provenance studies, reservoir characterisation and diagenetic studies.

Although the technique is widely applicable, for the petroleum industry it is most commonly used on sequences in which more “traditional” stratigraphic techniques are inadequate. The most common depositional setting that falls into this category is the continental fluvial environment. In such settings, correlation-related problems exist on many scales, but the two end members of this spectrum are detailed correlations within reservoir sandstones and regional correlations of entire sandstone-bearing intervals. Chemostratigraphy has been used to solve correlation problems for both these end members and examples of each are presented.

The detailed reservoir-scale example involves interwell correlation of a continental fluvial 40-80m thick sandstone-dominated package of Triassic age. In this example, which utilises sandstone and claystone core samples, chemostratigraphy allows recognition of a four-fold division of the reservoir across an area of approximately 50 km, plus an almost bed to bed correlation of more closely spaced wells. The correlation is based on geochemical recognition of changes in sandstone provenance, volcanogenic input and changes in syndepositional weathering.

The regional correlation example involves interwell correlation of Triassic/Jurassic age continental fluvial sequences that can be up to 1500m thick. In this example, which utilises claystone cuttings samples, chemostratigraphy allows correlation of 18 geochemical units over distances of up to 20km. The correlation involves recognition of changes in sediment provenance and changes in paleoclimate.

Bibliography

BHATIA, M. R. & CROOK, K. A. W., 1986. Trace element characteristics of graywackes and tectonic setting discrimination of sedimentary basins. *Contrib. Mineral. Petrol.*, **92**, 181-193.

BHATIA, M. R., 1983. Plate tectonics and geochemical composition of sandstones. *J. Geol.*, **91**, 611-627.

BHATIA, M. R., 1985. Rare earth element geochemistry of Australian Palaeozoic graywackes and mudrocks: provenance and tectonic control. *Sediment. Geol.*, **45**, 97-113.

DE LANGE, G. J., JARVIS, I. & KUIJPERS, A., 1987. Geochemical characteristics and provenance of late Quaternary sediments from the Madeira Abyssal Plain. In, Weaver, P. P. E. & Thomson, J., (eds), Geology and Geochemistry of Abyssal Plains. *Spec. Publ. Geol. Soc. London,* **31**, 147-165.

HERRON, M. M., 1988. Geochemical classification of terrigenous sediments using log or core data. *J. sediment. Petrol.*, **58**, 820-829.

JARVIS, I. & HIGGS, N. C., 1987. Trace-element mobility during early diagenesis in distal turbidites: late Quaternary of the Madeira Abyssal Plain, N. Atlantic. In, Weaver, P. P. E. & Thomson, J., (eds), Geology and Geochemistry of Abyssal Plains. *Spec. Publ. Geol. Soc. London.,* **31**, 145-151.

JARVIS, I., GRAY, A. L. & HOUK, R. S. 1992. *Handbook of Inductively Coupled Plasma Mass Spectrometry*. Blackie, Glasgow, 172-224.

JORGENSEN, N. O., 1986. Chemostratigraphy of Upper Cretaceous Chalk in the Danish Sub-basin. *Bull. Am. Assoc. Petrol. Geol.*, **70**, 309-317.

PEARCE, T. J., 1991. *The geology, geochemistry, sedimentology and provenance of Late Quaternary turbidites, Madeira Abyssal Plain.* PhD. thesis, CNAA, Kingston Polytechnic.

PEARCE, T. J. & JARVIS, I., 1992a. The composition and provenance of turbidite sands: Late Quaternary Madeira Abyssal Plain, *Mar. Geol.*, **109**, 21-51.

PEARCE, T. J. & JARVIS, I., 1992b. Applications of geochemical data to modelling sediment dispersal patterns in distal turbidites: Late Quaternary of the Madeira Abyssal Plain, *J. sediment. Petrol.*, **62**, 1112-1129.

PEARCE, T. J. & JARVIS, I., 1995. High-resolution chemostratigraphy of Quaternary distal turbidites: a case study of new methods for the correlation of barren strata. In, Dunay, R. E. & Hailwood, E. A., (eds), Dating and correlating biostratigraphically barren strata, *Spec. Publ. Geol. Soc. London.,* **89**, 107-143.

PEARCE, T. J., WRAY, D., WRIGHT, D. K. & BESLY, B., 1998. Chemostratigraphy and provenance of Westphalian C sequences: Geoscience 98 abstract.

PEARCE, T. J., BESLY, B. M., WRAY, D. & WRIGHT, D. K., 1999. Chemostratigraphy: a method to improve interwell correlation in barren sequences - a case study using onshore Duckmantian - Westphalian sequences (W. Midlands, U.K.). *Sediment. Geol.,* **124**, 197-220.

WRAY, D., 1990. *The petrology of clay-rich beds in the Turonian (Upper Cretaceous) of the Anglo-Paris Basin.* PhD thesis, CNAA, City of London Polytechnic.