An observation on transition elements of black shales in the Gondwana and Tertiary basins, India

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Permocarboniferous Damodar valley shale from Gondwana basin and Late Oligocene Tikak Parbat shale from Upper Assam basin have been considered to be a good source rock due to their hydrocarbon generation potential [1]. In this study trace elements and rare earth elements (REE) patterns of these (Gondwana and Tertiary) shales were analysed to understand their provenance characteristics and paleo-redox conditions. Shales having similar kerogen type can be differentiated by the fingerprints of their metal concentrations [2]. Hence an effort has been made to find out the relationship between kerogen type, thermal maturity and transition metals. La/Sc, Th/Sc, Th/Co, Th/Cr, and Cr/Th ratios of shale samples were compared to those of sediments derived from felsic and basic rocks along with UCC and PAAS ratios. This comparative study revealed that these ratios are within the range of intermediate to felsic rocks. The La/Sc vs. Th/Co plot also confirms the aforementioned observation. The geochemical parameters such as U, authigenic U, U/Th, V/Cr, Ni/Co and Cu/Zn ratios indicate that these shales were deposited under anoxic condition. The concentrations of the metals (As, Cd, Cr, Co, Cu, Ze, Mn, Ni, Pb and V) in the black shale samples varies with the type and maturity of the organic matter and these metals also acts as fingerprint to differentiate shales from different basins with similar type of kerogen. The correlation of these metals with thermal maturity exhibits a negative linear pattern suggesting that the concentrations of these metals decrease with increasing thermal maturity of the shales. However a non-linear correlation was observed between the total organic carbon (TOC) and the abundance of the transition metals. These observations are suggestive, to the fact that the abundace of the metals is influenced by thermal maturity of shale rather than TOC.

[1] Varma *et al.* (2014) *J. Nat. Gas. Sci. Eng.* **18**, 53-57.
[2] Akinlua *et al.* (2007) *Fuel* **86**, 1358–1364