A COMPARISON BETWEEN GEOCHEMICAL AND GEOPHYSICAL STUDIES OF THE THERMAL AND CHEMICAL CONSEQUENCES OF IGNEOUS INTRUSIONS, SE PARNAÍBA BASIN, BRAZIL

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The Parnaíba Basin has a stratigraphic fill of no more than 3.5 km, which makes the maturation of hydrocarbons problematic. Maturation as a result of Late Palaeozoic igneous intrusion has been suggested on the basis of geophysical mapping of sill frequency and basin modelling. New geochemical-mineralogical approaches have been used to confirm the thermal effects of igneous intrusions in triggering source-rock maturation in the basin.

Organic elemental analyses (OEA) have revealed upward depletion of TOC (%) in the basin stratigraphy in contrast to enrichment of the maximum extractable organic matter (wt/g rock) and the saturated fraction. Gas chromatograms of aliphatic HC fractions reveal the predominance of straight-chain components over isoprenoids and cyclic-dominated hydrocarbons. CPI and OEP-1 values decreases toward intrusive contacts. Taken together, these data suggest that the distribution of normal alkanes is skewed towards low molecular weight with increasing thermal maturity. Biomarker thermal maturity parameters [e.g. hopane isomerization (22S/22S+22R), sterane (20S/20S+20R), Ts/ (Ts+Tm), and triaromatic steroids] increase with decreasing distance from intrusive contacts. Epimers 22S-hopane and 20S-sterane ratio, show an inversion after the equilibrium stage, probably reflecting the impacts of higher temperatures closer to the intrusive contacts.

In general, geochemical data reveal increasing thermal maturity upwards in the Parnaíba Paleozoic stratigraphic sequence. Distribution of sills and dykes is a trigger factor for petroleum system evolution by heating source rocks both regionally and locally, resulting in thermal overmaturity in some places. As a consequence, so called “synthesis gas” may have occurred within a short distance of the volcanic intrusive contacts *(*e.g. in the Pedra de Fogo Formation).

Sills intrude into three main stratigraphic positions: A: mainly in the Silurian sequence; B: in the top of the Devonian sequence; and C: in the Carboniferous-Permian sequences. Close to the sills, sedimentary structures are obliterated by contact metamorphism; complete recrystallization of the mineral matrix and nucleation of new mineral phases has occurred. Smectite diagenesis occurs simultaneously in time and space with the maturation of organic matter. Illite/smectite (I/S) compositional ranges can be correlated with the levels of organic matter maturity. The data reflect systematic decreases in the proportion of illite in I/S mixed layers with increasing the distance from the nearest intrusion, providing still more evidence that thermal alteration derives from heating by igneous intrusions.

This comparison between geochemical and geophysical approaches for delineating impacts of volcanic intrusions on the Paleozoic succession, demonstrates the efficacy of inexpensive-geochemical approaches as back-up to high resolution geophysical studies. Geochemical approaches yield high-precision data to measure the influence of volcanic intrusions on thermal maturity and geochemical composition of the host rocks.

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Key words: geochemical-geophysical studies; clay assemblages; volcanic intrusions and maturity.