

Organic Geochemical and Petrographic Signatures of Hydrocarbons in Igneous Systems

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ABSTRACT

The interactions between igneous events and hydrocarbon systems are varied. For example, earlier igneous events can result in elevated heat flow or nutrient leaching which may simulate phytoplankton growth in an overlying water column or rapidly mature source rocks. Igneous systems can, however, have their own organic processes independent of a significant hydrocarbon charge. The objective of this poster is to present organic geochemical and petrographic data from a range of igneous environments which are independent of hydrocarbon charges. Igneous processes can be H₂O- or CO₂-rich (e.g., New Zealand or East African Rift). A relatively common feature of igneous systems are hot springs, or fumaroles, which frequently contain hydrocarbons atypical of those in petroleum charges. High temperature systems have been shown to contain a range of halogenated hydrocarbons (e.g., Schwandner et al.) based on substituted C₁-3 and benzene. Cooler systems have been shown to yield a range of hydrocarbons based on microbial systems (e.g., Mountain, Shock). Petroleum type hydrocarbons have been described from black smoker mineralising systems (Simoneit and Grimalt), in which H₂O is the H-donor during cracking (Hoering, Siskin). In bitumen from a CO₂-dominant volcano, atypical hydrocarbon compositions have been postulated to reflect the absence of a H-donor during cracking (Gize and MacDonald).

The quantities of extractable hydrocarbons associated with normal volcanic activities are probably quantitatively minor, and are anticipated to be heavily diluted in a significant hydrocarbon charge. Organic petrography is suggested to be a more reliable technique for recognising hydrocarbons influenced by igneous events (Newman et al., this meeting). It is suggested that the hydrocarbon optical properties in response to thermal alteration can be interpreted primarily as graphitising or non-graphitising carbons, dependent on the concentration of hetero-atoms in the starting material (Franklin). In the presence of water (e.g., hydrothermal systems), pyrolysates can be observed, interpreted as resulting from H-donation and disproportionation (Horsfield). In some cases, the cooling stage of a hydrothermal system may be slow enough to result in orientation of bitumen anisotropy perpendicular to the bitumen water contact (Gize, various refs), a process not observed in bitumen quenched in a relatively anhydrous system (Ixer et al.). Finally, superimposed on the textures developed by hydrothermal systems, are processes such as reorientation of optical anisotropy by stress.