Geophysical Research Abstracts
Vol. 19, EGU2017-10195, 2017
EGU General Assembly 2017

Continental Rifts and Resources

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Nearly all resource-forming systems involve upward mobility of fluids and melts. In fact, one of the most effective means of chemically transforming the earth's crust can be readily observed in the rift environment. Imposition of rifting is based on deeper stresses that play out in the crust. At its most fundamental level, rifting transfers heat and fluids to the crust. Heat delivered by fluids aids both in transport of metal and maturation of hydrocarbons. The oxidizing capacity of fluids on their arrival in the deep crust, whether derived from old slabs, depleted upper mantle and/or deeper, more primitive mantle, is a fundamental part of the resource-forming equation. Oxidizing fluids transport some metals and breakdown kerogen, the precursor for oil. Reducing fluids transport a different array of metals.

The tendency is to study the resource, not the precursor or the non-economic footprint. In doing so, we lose the opportunity to discover the involvement and significance of initiating processes; for example, externally derived fluids may produce widespread alteration in host rocks, a process that commonly precedes resource deposition. It is these processes that are ultimately the transferable knowledge for successful mineral and hydrocarbon exploration.

Further limiting our understanding of process is the tendency to study large, highly complex, and economically successful ore-forming or petroleum systems. In order to understand their construction, however, it is necessary to put equal time toward understanding non-economic systems. It is the non-economic systems that often clearly preserve key processes. The large resource-forming systems are almost always characterized by multiple episodes of hydrothermal overprints, making it difficult if not impossible to clearly discern individual events. Understanding what geologic and geochemical features blocked or arrested the pathway to economic success or, even worse, caused loss of a resource, are critical to exploration. Central to resource-forming systems is the role and tempo of rifting, and the integrity of the geologic lid on the system. Whereas compressional subduction begets storage, extensional rifting is about release and upward migration.

Comparison will be made of the older, Permian Oslo rift with minimal mineralization, and the younger, active Rio Grande rift in Colorado with extensive mineralization – discussing what we are missing in the way we study them.