Geophysical Research Abstracts,
Vol. 11, EGU2009-6698, 2009
EGU General Assembly 2009
© Author(s) 2009

Tectonic controls on hydrothermal mineralisation in hot continental crust: Thermal modelling and spatial analysis

K. Gessner (1,2) and A. Porwal (1,3)

(1) The University of Western Australia, School of Earth and Geographical Sciences, Crawley, Australia (klaus.gessner@uwa.edu.au), (2) CSIRO Exploration and Mining, 26 Dick Perry Avenue, Kensington WA 6102, Australia, (3) Western Australian School of Mines, Curtin University of Technology GPO Box U1987, Perth WA 6845, Australia (alok.porwal@gmail.com)

Hydrothermal ore deposits provide a record of excess energy flux and mass transfer in the Earth's lithosphere. The heterogeneous distribution of ore deposits in space and time provides a challenge to uniformitarian geodynamic and tectonic concepts, but unusual thermal and structural events often coincide with high mineral endowment. In the Australian Proterozoic continental backarcs and intracratonic rifts host large resources of base metals, gold, and uranium. We present thermal models and spatial analyses of mineral occurrences within the Mount Isa Inlier, an inverted Mesoproterozoic rift in northwest Queensland, Australia, to demonstrate how thermal structure, tectonic style and crustal scale fluid flow are related. In the Mount Isa Inlier, radiogenic heat production contributes significantly to present day surface heat flow, and Mesoproterozoic geotherms of 40°C km-1 in the upper crust can be inferred from lithosphere-scale conductive models. The combination of thick continental crust and high temperatures implies that localization of deformation was limited to a thin upper crustal layer. During rifting mid-crustal rocks intruded by syn-extensional granites were exhumed as metamorphic core complexes in strike-parallel linear basement belts. The resulting horizontal strength contrast between sedimentary basins and shallow basement domains became a focus for deformation during subsequent crustal shortening. Our spatial analysis of mineral occurrences demonstrates that epigenetic copper mineralization at Mount Isa correlates positively with steep fault zones bounding linear basement domains, and granites within these domains. Mineralization potential is greatly increased, because high permeability along steep fault zones enables hydrothermal fluid flow between magmatic, metamorphic and sedimentary reservoirs. We argue that the deformation behavior of hot continental lithosphere generates a favorable environment for hydrothermal mineralization by linking shallow with deep crustal fluid reservoirs in steep fault zones. Understanding the link between high crustal temperatures, steep fluid pathways and hydrothermal activity is essential for exploration and production of mineral resources and geothermal energy, particularly in Precambrian provinces and continental backarcs.