FINITE ELEMENT MODELING OF FREEZING GRANITIC MAGMA CHAMBERS AND ATTENDANT HYDROTHERMAL MINERALIZATION

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Calculations of magma convecting in granitic stocks display spiraling flow, much like wisps of smoke from a pipe, often impinging on the outer edges of the roof and then wandering about, providing an explanation for mineralized cupolas. These computationally derived features are similar in form to classic molybdenum/tin porphyries. Particularly if the directed flow to the roof breaks through as a series of brief eruption events associated with Sn/Mo deposits. The tortuosity of the flow further resembles, for instance, the tin pipes at the Zaaiplaats deposit in South Africa. Modeling of hydrothermal circulation coupled to magma chamber convection and freezing provides support to the rule that structure controls all. Fracture zones act as short circuits to ground water flow and govern the distribution of attendant hydrothermal mineralization. The initial shape of the magma chamber also exerts control of the initial ground water circulation. Vertically oriented cylindrically shaped stocks imbedded in isotropic media (country rock with uniform permeability) apparently dictate rather uniformly distributed hydrothermal circulation around the stock. Spherically shaped magma chambers of mafic composition imbedded in country rock of uniform permeability apparently do not serve as readily as flow guides as do cylindrical stocks, providing instead asymmetric flow fields even though the media and boundary conditions are symmetric and uniform. Additional influences are the evolution of permeability with time due to dissolution and re-precipitation of minerals involved in the hydrothermal circulation.