Goldschmidt 2022 Abstract
https://doi.org/10.46427/gold2022.13088

MODELLING THE ORIGINS OF FINGER-LIKE CHONOLITHS IN LIP PLUMBING SYSTEMS

ZHUOSEN YAO[1], JAMES MUNGALL[2] AND RICHARD E. ERNST[2,3]

[1]China University of Geosciences

[2]Carleton University

[3]Tomsk State University

Presenting Author: yaozhuosen@cug.edu.cn

Understanding the formation of LIP-related sills and chonoliths in sedimentary basins is important because this process usually occurs with the transport and accumulation of sulfide liquids to form the Ni-Cu-PGE ores. These sills/chonoliths are mostly in the form of finger-like igneous bodies, which is attributed to the instability at interface between two fluids with different viscosities in the Hele-Shaw cell consisting of two flat parallel plates separated by a small gap (Fig. 1a). Magma emplacement induces the fluidization of sedimentary rocks, which generates a fluid-fluid interface between the less viscous magma and more viscous, fluidized sedimentary rocks. We use a fluid dynamics-based model of magma emplacement to examine this process exclusively. If a less viscous magma (10 Pa·s) replaces the fluidized mixture with an average velocity 1 m/s, the interface is unstable and the magma flow divides into 2-4 major fingers with complex shapes (Fig. 1b), compatible with the channelized sills in sub-volcanic environments. Decreasing flow velocity intensifies the stability of interface, and the magma flow evolves into two stable fingers with larger widths (Fig. 1c). When the width of Hele-Shaw cell increases from 45 to 90 m, the fingers become thinner and magma flow becomes more unstable (Fig. 1d). In contrast, if the Hele-Shaw cell has a thick gap (10 m), the interface forms a wide, stable, single finger in the center (Fig. 1e). On the other hand, the dynamic viscosity of magma rapidly increases along with cooling and crystallization, and hence the viscosity contrast between magma and fluidized mixture decreases during magma emplacement. In this condition, the initial formation of finger-like bodies occurs at the farther downstream, and the fingers get thinner, weaker and eventually disappear (Fig. 1f). Hence, the morphology of the available, fluidized space for intruding magma flow, especially the thickness and width of the unconsolidated sedimentary layer, are most important for the formation and pattern of magma fingers. Based on the numerical models here, further studies will be conducted soon to conclude with some generalizations likely to deepen our understanding of the formation of ore-bearing sills/chonoliths.