Downward injection of sulfide slurries: their role in the formation of Ni sulfide deposits

N.T. ARNDT[1], S.J. BARNES[2], J. ROBERTSTON[2], C.M. LESHER[2] AND S. CRUDEN[2]

[1]ISTerre, Univ Grenoble, CNRS UMR 5275, Grenoble, France, (arndt@ujf-grenoble.fr)
[2]CSIRO, 6151 Perth, Australia Steve.Barnes@csiro.au
[3]MERC, Laurentian Univ. Sudbury, Canada (mlesher@laurentian.ca)

Magmatic Ni-Cu sulfide deposits form when mafic-ultramafic magma interacts with rocks of the continental crust, which decreases the solubility of sulfide in the magma or adds sulfur to cause the segregation of immiscible sulfide liquid. Strongly chalcophile Ni, Cu and PGE concentrate in the sulfide and if this phase accumulates, an ore deposit is formed. Most models identify gravitative settling of dense sulfide liquid as the cause of sulfide accumulation but inspection of the textures and structures of orebodies indicates that the process is not so simple. Many ores consist of crystal mushes or breccias that are injected in pulses into the host intrusions; layers of massive sulfide commonly penetrate rocks beneath the intrusions.

These features can be explained if sulfide-rich masses of magma migrated from higher in the magmatic plumbing system. As magma ascends, the pressure drops and, particularly if the magma assimilates country rocks, it loses heat. This causes crystallization, which may be accompanied by the appearance of sulfide droplets. The density and the viscosity of the magma increases. Many ore-bearing intrusions are saucer-shaped with flat, sill-like bases and sloping margins. As magma flows up these margins, a dense and viscous sulfide-bearing mush accumulates near the lower border while crystal-free liquid ascends along the upper part. The process differentiates the magma, producing evolved decanted liquids that flows erupts as flood basalt. The magma interacts with the sulfide in the lower part of the conduit, enriching the sulfide in chalcophile metals. The mush layer periodically becomes unstable and slumps down the conduit, to be injected as pulses into the sill-like portions of the intrusions.

Effects of climate change and changes in atmospheric CO_2 levels on sources of terrestrial aerosol precursors

A. ARNETH[1], W. KNORR[2] AND M. WU[2]

[1]Karlsruhe Institute of Technology, Institute for Atmospheric Environmental Research (IMK-IFU) (almut.arneth@kit.edu)
[2]Lund University, Dept. Physical Geography and Ecosystem Analysis (Wolfgang.knorr@nateko.lu.se; Minchao.wu@nateko.lu.se)

The terrestrial biota is a significant source of aerosols and aerosol precursors. Emissions of biogenic volatile organic compounds, for instance, are known to contribute to the growth of secondary organic aerosols and hence exert a negative radiative forcing. Wildfire, as a second example, is a large source of black carbon, with a large positive climate forcing. Hence changes in terrestrial aerosol and aerosol precursor emissions constitute a large and highly uncertain factor in the assessment of future climate-pollution interactions, especially when dealing with the question: to what extent would climate effects of pollution control be counteracted by possibly enhanced biogenic and fire emissions?

From a terrestrial sources perspective, addressing this question requires a consistent, process-based modelling framework, to take into consideration a number of direct and indirect factors that affect emissions collectively. Both fire and BVOC emissions respond rapidly and directly to short-term weather effects, like warm temperatures enhancing BVOC emissions. Fire occurrence directly responds to hot dry conditions immediately. However, over years and decades, climate trends and trends in atmospheric CO_2 concentration also play an important role. For example. wetter conditions and/or higher CO_2 levels can enhance fuel and enhance rather than reduce fires. Vegetation productivity and changing composition must be taken into consideration, both for BVOC emissions and fire regimes. Changes in vegetation composition in response to changing fire regimes can also affect BVOC emissions regionally, while direct human land use is an additional crucial component to be considered for the assessment of future aerosol precursor emissions from terrestrial ecosystems, for both BVOC and fire.

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