EGU24-13826, updated on 20 May 2024
https://doi.org/10.5194/egusphere-egu24-13826
EGU General Assembly 2024

Understanding Ni-Cu Sulphide Deposits in a Plate Tectonic and Mantle Convection Context

Isadora Page[1], Ben R. Mather[1], Nicole Januszczak[2], Michele Anthony[2], and R. Dietmar Muller[1]
[1]EarthByte Group, School of Geosciences, The University of Sydney, Sydney, NSW 2006, Australia
[2]Metals Exploration, BHP, Toronto, Ontario, Canada

Nickel-Copper (Ni-Cu) sulphide deposits are a diverse class of deposits, formed during the cooling and crystallisation of metal-rich mafic to ultramafic magmas. Despite sharing several key ore-forming processes, many of these deposits form in contrasting geologic environments and periods. The objective of this research project is to investigate the spatial and temporal distribution of Ni-Cu sulphide deposits in a mantle convection and plate tectonic context, and to explore the influence of different mantle and tectonic parameters on their origins and occurrence. We first determine the location of these deposits in relation to relevant geologic and tectonic features through time, including subduction zones, large igneous provinces (LIPs), and mantle plumes. Using a 1 billion year plate model we extract key parameters relating to subduction, as well as the spatio-temporal distribution of LIPs through time. Employing an associated geodynamic model, we identify model mantle plumes and quantify their key properties. Preliminary findings indicate that certain mantle plumes associated with deposits exhibit increased plume flux in the upper mantle preceding deposit formation, and that many deposits are spatially associated with LIPs throughout their formation history. For several deposits located in convergent margin settings, we have identified a notable spike in subduction volume and convergence rate during a 50-100 million year period prior to the onset of mineralisation. While the angle of the subducting slab is highly variable throughout the evolution of these deposits, several deposits are associated with a distinct steepening of the subducting plate in the lead-up to deposit formation. The findings of this study aim to contribute new insights into the dynamic processes governing the genesis of magmatic Ni-Cu sulphide deposits. These insights aid in our understanding of the interplay between mantle dynamics, plate tectonics, and deposit formation, and hold implications for future critical mineral exploration.