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Applications of Voxel and Surface Geometry Magnetic Inversion in Modelling Seafloor Massive Sulphide Deposit Systems; East Manus Basin

Christopher Galley (1), Peter Lelievre (1), Colin Farquharson (1), John Jamieson (1), and John Parianos (2)
(1) Memorial University of Newfoundland, Earth Sciences, St. John's, Canada, (2) Nautilus Minerals, Vancouver, Canada

Seafloor massive sulphide (SMS) deposits are hydrothermally formed mineral deposits located on the ocean floor. These modern equivalents to volcanogenic massive sulphide deposits are rich in copper, gold, silver, and lead, leading them to be viewed as future economic resources.
An efficient way of studying the geometry and forming resource estimates of SMS deposits, despite their native remote environments, is through the inverse modelling of magnetic data collected by autonomous or remotely operated underwater vehicles. The primary alternate method of study now is drilling, which is difficult and expensive on the seafloor. This magnetic data can be inverted using a voxel-mesh modelling program to determine the regional characteristics of the hydrothermal system in three dimensions, and the effective magnetic susceptibilities of the deposit and host rock. A surface geometry inversion method can then be used to model a discrete volume of the massive sulphide lenses, allowing for tonnage estimates of an SMS deposit to be calculated. This surface geometry inversion method functions by modelling the Cartesian position of the vertices of a wireframe surface mesh, with the magnetic susceptibility values of all enclosed regions in the model remaining constant.
The data specific to this study was gathered over the Solwara 1 deposit, located in the East Manus Basin. Additionally, regional deep-tow magnetic data has been used to map the hydrothermal alteration surrounding Solwara 1, increasing our understanding of the convective systems which feed these deposits.