# Using altered enclaves in the identification of subseafloor replacement processes in VMS systems

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Progress in submarine hydrothermal system research has revealed that subseafloor replacement in VMS systems is an important mechanism that contributes to the formation of large tonnage and/or high grade VMS deposits (Doyle and Allen 2003, Piercey, 2015).

Recognizing diagnostic features of replacement in highly deformed and metamorphosed VMS deposits can be challenging. Genetic interpretation of rock inclusion found in deformed massive ores could lead to an erroneous conclusion if their provenance is not assessed properly. Rock inclusions in massive ores can form from a variety of sources eg. tectonic enclaves, post/late VMS intrusions, exogenous detritus in clastic ores and relicts of unreplaced host rocks, with only the latter contributing critical evidence to probe a replacement origin for the ore.

This contribution presents detailed examples of using lithogeochemical mineralogical and mapping techniques, to infer the extent of subseafloor replacement processes in the formation of the metamorphosed Pyhäsalmi and Storliden deposits which occur in the Proterozoic submarine arcs of Finland and Sweden.

The giant Pyhäsalmi deposit is inferred to have formed by combined processes that involve exhalation and replacement (Mäki et. al. 2015); whereas the small but high grade Zn-Cu Storliden deposit was originally thought to be a coarse grained hydrothermal replacement deposit based on its flat lying aspect and rock inclusions, but is now conceived as a seafloor exhalation with a minor volume of semi massive Cu ore replacing the feeder area.

## References:

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Piercey, S.J., 2015 A semipermeable interface model for the genesis of subseafloor replacement-type volcanogenic massive sulphide (VMS) deposits. Economic Geology, vol.110 pp.1655-1660