

# Geochemistry of the Larvik Plutonic Complex and its implications for the genesis of its Fe-Ti-P-REE mineralization

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The Larvik Plutonic Complex (LPC, SE Norway) is a large multi-sections complex which crystallized in the early stages of the Oslo Rift (~302-288 Ma), and has already been studied for its quartz to nepheline normative alkaline series [e.g. 1-4]. Its youngest ring-sections host local occurrences of Fe-Ti-P-REE rocks whose concentrations in phosphorus may be of economic importance, with REE as a byproduct [5]. The Kodal deposit is the largest occurrence and consists in a ~2000m dyke-like shaped orebody cutting through larvikite, with magnetite, ilmenite, apatite, titanium-bearing augite and phlogopite as main minerals. Previous studies offer mineralogical investigations but contrasting hypotheses about its formation (in-situ accumulation, silicate-liquid immiscibility and xenolith-like ascent) [5-8]. Here, we discuss the origins of these mineralization by comparing for the first time their geochemical signatures with those of the surrounding monzonitic rocks. Whole-rock elemental analyses, such as Nb/Ta ratios and REE spidergrams, indicate a common magmatic source for both the different ring-sections of host larvikite/lardalite and the Fe-Ti-P-REE mineralization. Light and heavy REE, as well as Eu/Eu\* variations, also show that the parental magma underwent successive extractions of plagioclase-rich magmas with very close to identical geochemical features to each other. Therefore, the orebodies did not form locally by in-situ fractional crystallization of a single batch of already emplaced monzonitic magma. Rather, mineralization is likely formed in the magmatic chamber of the LPC, by either silicate-liquid immiscibility or fractional crystallization of a residual melt, and is later brought up in the cooling larvikites [8]. Further whole-rock and in-situ measurements are planned in order to identify the source of the LPC and better constraint the formation of its mineralization.

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