Petrological significance of a sill-like mafic body reversely-zoned from the base to roof

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An unusual 160 m thick sill-like body of fine- to medium-grained pigeonite gabbro has been recently discovered in between Archaean basement gneisses and the Paleoproterozoic Koitelainen layered intrusion, NW Finland [1, 2]. The body is unique in showing remarkably systematic reverse fractionation trends from the base to the very top. These are exemplified by a significant upward increase in whole-rock Mg# from about 30% to 80%, and in normative An from about 20% to 70%. Especially noteworthy is the upward dramatic depletion in all incompatible trace elements. For instance, La reveals a 250-fold decrease from 27.5 ppm to 0.11 ppm and Zr shows a 340-fold decrease from about 170 ppm to 0.5 ppm. In addition, a systematic upward decrease in ratios of highly incompatible elements (e.g. Zr/Y from 9 to 1; La/Yb from 20 to 1) is observed. The finding of a magmatic body with such anomalous compositional features is puzzling since conventional mechanisms of magma differentiation are not capable of forcing magmatic systems to differentiate in the direction opposite to that predicted by liquidus phase equilibria [3]. Our tentative interpretation is that the anomalous compositions trends have been produced by the emplacement of increasingly more primitive magma followed by the recrystallization of the uppermost part of the partly solidified body, under the influence of the Koitelainen layered intrusion.

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Marine clouds over the Eastern Pacific in a regional climate model

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Cold sea surface temperatures in combination with warm, dry air aloft lead to the formation of persistent maritime stratocumulus decks over the eastern Pacific off the coasts of North and South America. These subtropical clouds have a major impact on the Earth's radiation budget by efficiently reflecting incoming solar radiation. Aerosol particles play a key role providing condensation nuclei for cloud formation. Changes in atmospheric aerosol due to anthropogenic activities are known to potentially alter cloud properties such as reflectivity or precipitation formation efficiency. The indirect aerosol effect is currently still poorly understood and its quantification remains highly uncertain. The tight coupling between atmosphere, ocean and land surfaces in the eastern Pacific region as well as the many spatial and temporal scales involved are challenging to model [1].

In this study, we implemented a double-moment cloud microphysics scheme [2] into the International Pacific Research Center (IPRC) regional atmospheric model (iRAM) [3] to simulate marine boundary layer clouds over the eastern Pacific and to study aerosol-cloud interactions. An extensive comparison of results from iRAM with observations shows that the new model is able to reproduce average cloud properties reasonably well. We present an analysis of average microphysical cloud properties such as liquid water content and cloud droplet number concentrations from the results of a present-day model run. Furthermore, we investigate the sensitivity of cloud properties to changes in aerosol loading (indirect aerosol effect) as well as rising sea surface temperatures and changes in atmospheric temperature and humidity in the context of climate change.

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