Impact of basaltic sills on sedimentary host rocks in the High Arctic Large Igneous Province

Frances M. Deegan, Jean H. Bédard, Valentin R. Troll, Keith Dewing, Steve E. Grasby, Hamed Sanei, Chris Harris, Carmela Freda, Valeria Misiti, Harri Geiger, Erika Hagerfors & Carol A. Evenchick

frances.deegan@geo.uu.se

In the Canadian Arctic Islands, a complex network of dykes and sills are exposed that belong to the High Arctic Large Igneous Province (HALIP). The HALIP is a Mesozoic continental basalt suite, which intruded volatile-rich sedimentary rocks of the Sverdrup Basin (shale, limestone, sandstone, and evaporite) some 130 to 120 million years ago. In this study, we document how the thin (mostly <20m) sills of the HALIP have affected shaly host rocks (some organic-rich) on Axel Heiberg and Ellesmere Islands in the Canadian Arctic Archipelago. These magmatic intrusions can advect considerable amounts of heat into the crust, potentially generating large amounts of greenhouse gases from carbon and sulphur-rich host rocks. We focus on a specific narrow sill (17m) that experienced limited extents of internal differentiation after emplacement, as shown by the near-absence of internal bulk chemical evolution. A detailed traverse of this sill revealed variable magmatic d34S and d18O values, which is evidence for incorporation of crustal material. To gain insights into the actual processes involved in crustal digestion by sills, we carried out magma-shale interaction experiments at magmatic temperature of 1250°C for 600 s. The experiments document break-down of shale into magma and vigorous crustal degassing. Our initial results thus provide fresh insights into the actual processes and time-scales of magma-sediment interaction, which has been hypothesised to be a key factor in modulating the environmental impact of LIPs.