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The dark, dramatic peaks of Svalbard and how they formed

Earth is made up of tectonic plates, and volcanism is common at the edges of them, where new crust is being created or destroyed. Sometimes volcanism is also found in the middle of plates, like in Hawaii today. For magma to come up within a tectonic plate, the mantle underneath the crust must be hotter than usual, which allows pockets of molten rock to move upward and reach the surface. Areas of hotter mantle, or hotspots, have existed for most of Earth's history, and when they cause large eruptions, the greenhouse gases released can have a big impact on the global climate and all living things. In the High Arctic, evidence of such a hotspot has been found. Large volumes of magma were brought close to Earth's surface in pulses between 130 and 80 million years ago, and these can today be found on Canadian and Russian Arctic islands, in Greenland and on Svalbard. To get a better understanding of how this magma ended up in the High Arctic and where it came from, a team of five international scientists visited a remote fjord in Svalbard, called Ekmanfjorden, in the fall of 2020. In this fjord, the black intrusions cover most of the peaks, and to get close to them, the mountains must be climbed. Samples of these magmatic rocks were collected, and countless photos were taken using drones. Seventy kilograms of rock were carried down the mountains and brought back to the Department of Geology at Lund University, where the rocks were crushed and cut for detailed analysis. To get a better understanding of how the rocks formed, some of the material was sent for geochemical analysis. By studying some of the smallest components within the rock, the trace elements, it is possible to unravel where the magma that crystallized in Ekmanfjorden originally came from. The ratios between different trace elements show that the magma came in two separate pulses. The most dominant magma pulse came from mantle rocks over 80 km deep, which contain the mineral garnet. The other pulse began with melting in the same deep source, but this melt was then brought up to shallower depths, where more melting occurred. In both cases, as the melt was brought up to the surface, the minerals olivine, plagioclase, and possibly clinopyroxene crystallized, and components from the surrounding crust were incorporated into the magma. When the magma reached just beneath the surface, it spread out between rock layers that were several million years older, and slowly cooled down into a rock. As time passed by, these rocks were slowly eroded away, aided by wind, water and finally the large glaciers covering Svalbard during the Ice Age. The magma that once ascended from over 80 km down in the mantle, today makes up the dark, dramatic peaks of Ekmanfjorden.

One of the impressive peaks in Ekmanfjorden, with its dark magmatic rocks. The fjord can be seen in the background.