High-resolution multibeam Sonar mapping of the submarine ikaite columns and structures in Ikka Fjord, SW Greenland

Paul G. Seaman [a], Erik Sturkell [b,*], Richard Gyllencreutz [c,d], Gabrielle J. Stockmann [e], Halldór Geirsson [e]

[a] Independent scientist, UK, Kinross, Scotland, seaman_paul@yahoo.com ; [b] University of Gothenburg, Sweden, erik.sturkell@gvc.gu.se ; [c] Bolin Centre for Climatic Research, [d] Stockholm University, Sweden, Richard.Gyllencreutz@geo.su.se ; [e] University of Iceland, Iceland, gabrielle@hi.is; [e] University of Iceland, Iceland, hgeirs@hi.is

Ikka Fjord in SW Greenland is renowned for the hundreds of impressive submarine tufa columns and structures found scattered about its shallow length. These life-encrusted, stalagmite-like structures are up to 20m high and composed significantly of the 'rare' cold-water carbonate mineral ikaite ($CaCO_3 \cdot 6H_2O$). The fjord is the type locality for this mineral after which it is named. Ikka Fjord and the fragile and beautiful columns it contains has been the focus of multidisciplinary studies by scientists from predominantly Nordic countries who have come to refer to themselves and 'The Ikka Projekt'. The earlier phases of the investigations of the locality were aimed at understanding the processes behind the formation of the deposits, mapping their distribution and recording the abundant life-forms found living on and within the columns and structures. Recent discoveries of ikaite formation in Arctic and Antarctic sea ice and new laboratory studies has led to a resurgence in interest in Ikka Fjord and ikaite as these findings suggest that this rapidly precipitating carbonate mineral has the potential to be used as a carbon sequestration medium. With much still to learn about the precipitation of ikaite in Ikka Fjord, recent expeditions have been conducted to acquire new samples and to better map the deposits and the marine and terrestrial environment of the fjord. To this end a high-resolution multibeam sonar bathymetry survey was made in Ikka Fjord in the summer of 2019. This survey provided highly detailed maps of the floor of the fjord and data that could be used to chart column heights and distributions. The data also identified several hitherto unknown pockmarks on the seabed. A total of 938 individual columns and structures ranging 0.5–20 m in height measured from the sea floor were identified. The results supported previous observations that the columns are restricted to the spatial extents of the Grønnedal-Íka igneous complex. Column distribution exhibits lineations and variable density over the fjord floor. The tallest columns are observed to reach and then terminate at the levels of a halocline at approximately 2–4 m water depth. If the halocline marks the limit of growth, then majority of columns have reached only 15–50% of their growth potential. The 60 or so columns achieving their maximum growth potential stand in clusters, interpreted as representing exceptionally favourable growth settings. New data collected in 2019 shows a worrying increase in seawater temperature compared with measurements made in 1995 and 2007–2009. Given that the formation and stability of ikaite favours low temperatures, increases in seawater temperature could potentially affect the stability of the delicate columns of Ikka Fjord.