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Gjensyn med Elgfjellet

Elgfjellet revisited

Elgfjell lies below the steep eastern slopes of Jordhulefjell in Grane kommune, south Nordland, within the Lomsdal-Visten National Park. It comprises an upland plateau c. 8 km2 in size, with several minor peaks above 600 m altitude, and is within the Helgeland Nappe Complex of the Scandinavian Caledonides. Two types of marble occur: a pure grey variety of Low Magnesian Calcite with >96% $CaCO_3$ and a rarer yellow-brown striped variety of High Magnesian Calcite with 16-17% $MgCO_3$, which is not dolomite. Many dolines and cave entrances lie at the junctions of the two marble types, and caves occur in both. The first caving visits to the lower Jordbruelv valley, 5,7 km to the south, were in 1984 and 1986, when Jegerhullet, Etasjegrotta, Bjørkåsgrotta and Anastomosegrotta were found. In 1988, 79 caves were explored at Elgfjell, with a total passage length >4 km, including Elgfjellhola and Musk Cave. A second expedition in 1989, led by Geoff Newton, found Secret Stream Cave, Pustehola and Cave of the Brown Stains, but the entrance to the unsurveyed Musk Cave was covered by snow. My own second visit to Elgfjell in 2000 mapped the various marble outcrops and recorded the cave entrance locations using GPS. Because of remaining snow, Musk Cave was not entered and Elgfjellhola was almost hidden, so that the 'new' Paradox Cave was found first. A mini expedition in 2004 surveyed and photographed Paradox Cave and made a surface survey, but Musk Cave was again hidden under snow. The 2006 mini expedition camped beside the Upper Jordbruelv, but the reported caves there were extremely short, and so a spontaneous decision was made one afternoon to make a lightning visit to Elgfjell. This time, the entrance to Musk Cave was completely open and its position was recorded and its description checked. On a subsequent trip to Elgfjell in 2008, we slept inside Shelter Cave, which was a mistake in the damp and windy conditions. We continued the surface survey and managed to enter and survey Musk Cave, despite the entrance being almost blocked by a large snow plug. Shelter Cave, Musk Cave, Pustehola and Cave of the Brown Stains comprise one system that, if connected, would approach a kilometre in length. This article mainly reports the additional caves that have been explored since the 1988 and 1989 expeditions, including those in the adjacent areas of Gåsvasstind, Upper Jordbruelv and Bienjenbaektie, together with fuller discussions about the more significant caves on Elgfjell in Valleys 3S and 4S. Table 1 provides a complete list of all the known caves, with the best available location data, but with coordinates to ED50, consistent with previous reports. Various neotectonic movements, observed both above and below ground are recorded, together with the sizes and orientations of some scallops on passage walls. Paradox Cave is paradoxical because the passage leads down to a static sump, but up the valley to the north. Scallops also point north. The sump is only c. 30 m from, and at a similar level to, the silt choke in Secret Stream Cave, to which it probably connects.

Elgfjell contains the highest density of caves in south Nordland and is significant in Norway. It is difficult to explain the formation of the many relict phreatic passages by conventional, interglacial, theories, because they are unlikely to have experienced phreatic conditions by submersion under water during the Holocene. Additionally, their superficial nature suggests that few of these passages could survive the glaciation that follows their formation, because of the erosion of their bedrock, which is known to have been especially large in the Elgfjell-Jordbruelv area. The necessary inception factures in the marble were probably created earlier by deglacial earthquakes, as evidenced by the observed tectonic movements and slickensides. Flows of unsaturated water through these fractures were then provided from the deglacial ice-dammed lakes (IDLs) that formed in the area when the surface of the Weichselian ice sheet started to melt and to lower from the start of the Bølling period at c. 13,50014Ca BP. From earlier modelling of the evolution of the IDLs for the whole of Central Scandinavia and for the Tosenfjord-Fiplingdal area in more detail, the marbles around Elgfjell probably became submerged by clean meltwater IDLs, initially without sediments, between 11,000 and 10,700 14Ca BP, as the ice surface lowered from 1000 m to 900 m altitude. During the lowering of these IDLs, their surface levels were controlled by more than 20 passes along a major ridge west of Jordhulefjell. Several of these have a significant gorge on the coastal side of the ridge, suggestive of a jökulhlaup at the time of the change in lake level and subsequent strong reverse (westward) outflows through these passes. Fractures and caves on Elgfjell experienced high flow regimes beneath the Elgfjell IDL, especially those near the lake surface. There were also switches in the flow direction, because some local pass-points lie to the north and others to the south, which explains the anomalous flow directions of the north-pointing scallops in Elgfjellhola, Paradox Cave and Pustehola. Adjacent IDLs grew larger and coalesced, to form an interconnected system of glacial lakes extending for c. 70 km along the east side of the mountains, with a mean width of c. 3 km, giving a total surface area of c. 200 km2 and a possible maximum depth of 500 m. After the last jökulhlaup at the lowest pass at 700 m altitude, the large IDL trapped within the ring of mountains at the head of the Jordbruelv and the Gåsvasselv reverted to summer northward flows along ice contact spillways and eastward flows that became part of the ice sheet hydrology, whilst still submerging the many caves on Elgfjell that have altitudes just below 600m. Underground flows were now commonly aligned to the south. By 9,800, the ice margin had crossed the deglaciated mountain range to the western side of the large valley glacier still occupying Svenningdal, which then had an upper height of c. 500 m. Most of the caves on Elgfjell were now drained, to experience interglacial conditions similar to the present. It is suggested that many of the relict phreatic passages were submerged beneath the Elgfjell IDL for a sufficiently long time to have enlarged to present sizes by dissolution under the prevailing unsaturated high-flow hydraulic regime, despite the low temperature and low level of PCO_2. Those caves and fractures in locations that received allogenic drainage then experienced a primarily vadose entrenchment throughout the Holocene. The complexity of several of the Elgfjell caves, including the interconnected Shelter Cave / Musk Cave / Pustehola / Cave of the Brown Stains system, which displays major phreatic passages at three levels with only minor vadose modifications, suggests that they have developed over two or three deglaciation events. The small sizes and rarity of speleothems on Elgfjell suggests that they are all of Holocene age, and that any older deposits were removed during deglaciation. To consider speleogenesis in this fascinating area in more detail would be rather speculative at present: a deeper understanding requires more precise studies of passage morphologies, scallop sizes and orientations, and, especially, analysis of the rather limited chemical and clastic deposits.