Cligga Head, Cornwall

[SW 738 536]

Introduction

The Cligga Head GCR site comprises two major sections, both illustrating extremely fine examples of endogranitic greisen vein swarms resulting from the fracturing of a granite cusp. Cligga Head is situated on the coast 1.5 km south-west of Perranporth (see (Figure 7.28)).

Around the derelict remains of the Cligga Mine buildings, near to the position of Contact Shaft, the dumps of waste material contain fine representative samples of the veinstone and the country rocks. The granite is a coarse, white, porphyritic variety grading into, or veined by, dark-grey, finer-grained greisen (quartz-mica rock). The vein material consists mainly of quartz with chlorite and tourmaline, together with the ore minerals cassiterite, wolframite, chalcopyrite and arsenopyrite. To the north-west of the mine, a small quarry at the top of the cliff faces northeastwards towards Perran Beach. In this quarry can be seen the numerous parallel greisen-bordered veins which have made this locality an internationally important mineralogical site (see (Figure 7.29)).

From the northern end of this quarry a path leads around the headland, to views of a near-vertical 90 m-high sea-cliff and the beach of a small cove. Looking along the strike of the veins from above the cove, numerous holes mark the entrances (adits) to many old mineral workings. Mining here of tin and tungsten probably goes back to Prehistoric times, and continued on and off until 1945. As a mining proposition, the deposit resembles a stockwork but it was not thought to be rich enough to be worked by opencast methods. All the exposures have been extensively studied, leading to a considerable literature on the petrological and mineralogical features, including papers in Hosking and Shrimpton (1966) which discussed the mineralization at Cligga Head, Hall (1971) who studied the chemical and mineralogical changes associated with greisenization, and Moore and Jackson (1977) who described the mineralization in terms of the local structural patterns. Dines (1956) presented a detailed account of the mineralization and mining, while a general description is given in Selwood *et al.* (1998).

Description

The sea-cliff and quarried section expose the remnant of the eastern side of a granite boss belonging to the Cornubian Batholith, of Amorican age intruded into Devonian slates ('killas) which have been contact metamorphosed. Contacts with the highly metamorphosed killas at the eastern and southern margins are steep but irregular. Innumerable joints, in the main trending ENE–WSW and underlying steeply northwards, traverse the whole mass. In the vicinity of the joints the granite is greisenized. The granite is also riddled with quartz veins, many of which contain tourmaline, cassiterite, wolframite and stannite. Indeed the tin sulphides and their oxidation products are the most characteristic minerals of the area. Varlamoffite, the secondary alteration product of stannite, was first recorded from this locality. Fine crystalline specimens of some secondary minerals have also been recorded from this locality, for example scorodite, olivenite and pharmacosiderite.

The numerous parallel veins at both the quarry section and sea-cliff range in thickness from a few centimetres up to more than 30 cm. Each vein is bordered by bands of greisen, whilst between the greisen bands the granite is often kaolinized and soft. The veins in the quarry section virtually all dip to the north at a high angle. However in the cliffs the veins appear to be curved into the shape of an anticline and syncline (Figure 7.28). They occupy planes in the granite that are roughly parallel to the contact and form a type of stockwork. Southwards the veins become less numerous and lose the parallelism seen in the quarry section. The rocks also become increasingly iron-stained, along with patches of green colouration, indicative of the presence of copper-bearing veins.

From the beach it can be seen that some adits of Cligga Mine open onto the beach. Boulders and cliff rock debris of the quartz veinstone containing black wolframite and other minerals are quite common on the beach.

Marine erosion of the veins and beach boulders ensures a continuing supply of mineral specimens on the beach, and a rough ore concentration is present due to tidal action.

A large number of mineral species are recorded from Cligga Head, including for instance cassiterite, isostannite stannite, chalcocite, molybdenite, arsenopyrite and wolframite. Cligga Head is also the type locality for the mineral ferrokesterite (Kissin and Owens, 1989). However, Ryback *et al.* (2001) have demonstrated that the late A.W.G. Kingsbury falsified the localities of numerous rare mineral species. This deception affects a number of locations in the South-west England, including Cligga Head. Therefore care should be exercised when considering claims by Kingsbury which have not been substantiated or duplicated by subsequent collectors.

Interpretation

The Cligga Head granite has been shown by gravity surveys to be a cusp on the surface of an ENE–WSW-trending granite ridge forming the largely concealed St Agnes–Cligga Head granite cupola (Bott *et al.,* 1958). The granite is essentially a type-B megacrystic variety, but the presence of zinnwaldite instead of biotite, along with abundant late muscovite ('gilbertite') and topaz, suggest metasomatism by a possible Li microgranite. The granite–killas junction is exposed at the southern end of the western cliff-face. Approximately 2 m from the contact the killas is highly tourmalinized, and beyond that is bleached and traversed by small quartz veins.

The endogranitic greisen veins are joint-orientated. The hard, brownish greisen bands contrast strongly with the white or buff colour of the granite. In the greisen the original feldspars are altered to quartz and muscovite with associated topaz, while occasionally nests of 'gilbertite' and occasional cassiterite crystals are found. The joints, alongside which the greisen occurs, range from thin partings to sometimes fissures up to 15–20 cm in width. In the southernmost 165 m of the section the veins are barren of ore mineralization, and here the greisen has been worked for roadstone.

Alteration of granite to a greisen assemblage of quartz, white mica and in places topaz is a relatively common feature of the Cornubian Batholith granite plutons, especially at their margins. The greisen alteration commonly encloses veins of quartz with variable amounts of cassiterite and/or wolframite, löllingite and other minor sulphides. These greisen-bordered veins often form sheeted complexes in the granite bodies. Usually the greisen-bordered sheet-vein systems show no brecciation and appear to be the result of hydraulic fracturing with controlled egress of hydrothermal fluids. Further, the development of sheeted greisen vein complexes is commonly accompanied by pervasive argillic or sericitic alteration.

In the past, discussions on the origin of greisenization have focused on the importance of fractures in relation to greisen-bordered sheeted-vein system. Hosking (1964) thought that the fractures at Cligga Head were thermal contraction joints, but later authors have seen the role of fracturing by high fluid pressure as being important (Moore and Jackson, 1977). Perhaps the critical control on the formation of sub-parallel sheeted-vein systems would appear to be the close physical proximity of hydrous fluids at high temperatures within a relatively cool enclosing granite, which has perhaps cracked during cooling.

Schneider (1993) studied thermochemical models for greisen alteration, and determined six zones that reflect distance from a fracture and also differences between the amount of fluid percolating into the rock and that simply moving along the fracture. Temperatures along the vein were taken to decrease from about 600°C to less than 400°C, with orthoclase feldspar being seen at the higher-temperature end, and the replacement of feldspar by muscovite at or below 400°C.

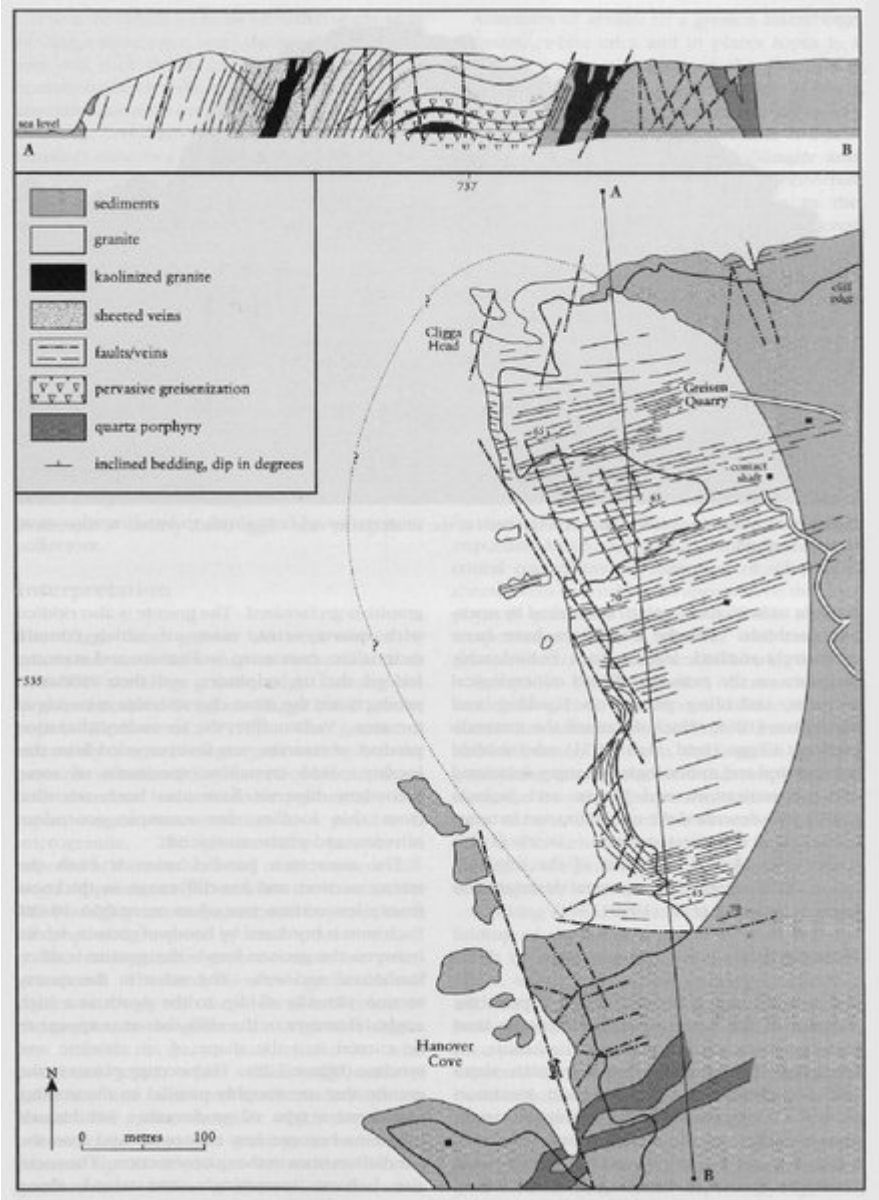
Hosking (1964) considered that the apparent folding of the greisen-bordered veins was the result of emplacement in a set of contraction joints, which had formed parallel to a former undulatory granite roof. However, Moore and Jackson (1977) thought that the contraction joint pattern follows the normal dome structure expected above the core of a crystallizing cupola but that faulting had caused modification of the dome on the south side of the core.

The sheeted-vein systems throughout Southwest England contain very large tonnages of low-grade ores, but somewhat surprisingly represent only a small proportion of the overall production of tin and tungsten.

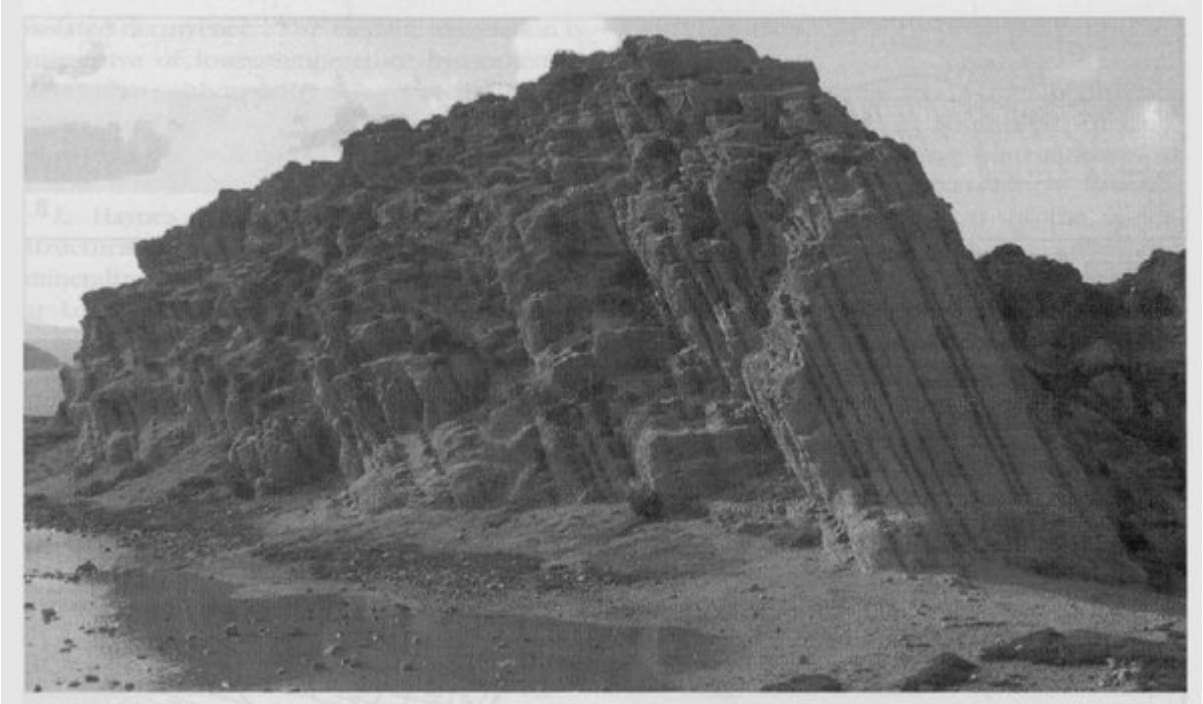
Conclusions

The Cligga Head area forms one of the finest exposures of endogranitic greisen-bordered mineral veins in Britain and most probably Europe. The site has attracted the attention of geologists since the early 1800s, when mining was active. The Sn- and W-bearing veins belong to the main-stage mineralization linked to the Cornubian Batholith of South-west England. Comparisons can be made with other areas with greisens in South-west England, for example at the St Michael's Mount and Cameron Quarry GCR sites.

References



(Figure 7.28) Structural, lithological and mineralogical interpretation of Cligga Head. After Moore and Jackson (1977).



(Figure 7.29) Parallel greisen-bordered veins, seen in the small quarry near Cligga Head. (Photo: N. Stevenson, Natural England.)