TRESSA NESS TO COLBINSTOFT

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Introduction

The site lies along the base of the Vord Hill Klippe of the Upper Nappe of the Shetland Ophiolite in Fetlar. The site is bound to the NW by a continuous low cliff exposing the base of the nappe, but not the thrust beneath it. Farther south the thrust is exposed in the coast and passes up the side of Stackaberg where it overlies thin slices of lower metagabbro which separate the nappe from the underlying metasedimentary phyllites of the Middle Imbricate Zone. The latter are also exposed in a window through both the klippe and the underlying metagabbro slices near the top of Stackaberg. Inland, to the east of the coastal section, the base of the klippe is seen to be intensely but crudely sheared, in many places in a phacoidal manner. This latter area is notable for the presence of a number of small rodingite (garnet-diopside-epidote-prehnite) bodies within unsheared metadunite lenses which form enclaves at the sheared base of the klippe (Phemister, 1964; Flinn, 1996).

Description

The site is bound to the west by accessible low cliffs of coarsely sheared serpentinite very close to the east-dipping basal thrust of the Vord Hill Klippe (Figure2.14). The klippe is composed almost entirely of ochrous-weathering, strongly serpentinized harzburgite which forms the central part of Fetlar. The thrust plane beneath the klippe is associated not only with intense shearing of the base of the nappe but also with recrystallization of the serpentinized harzburgite to a white-weathering antigorite serpentinite (see alsoThe Punds to Wick of Hagdale GCR site). Between Tressa Ness and Colbinstoft the zone of shearing and antigoritization extends about a quarter of a kilometre to the east of the coastal section and is very well exposed (Figure 2.15).

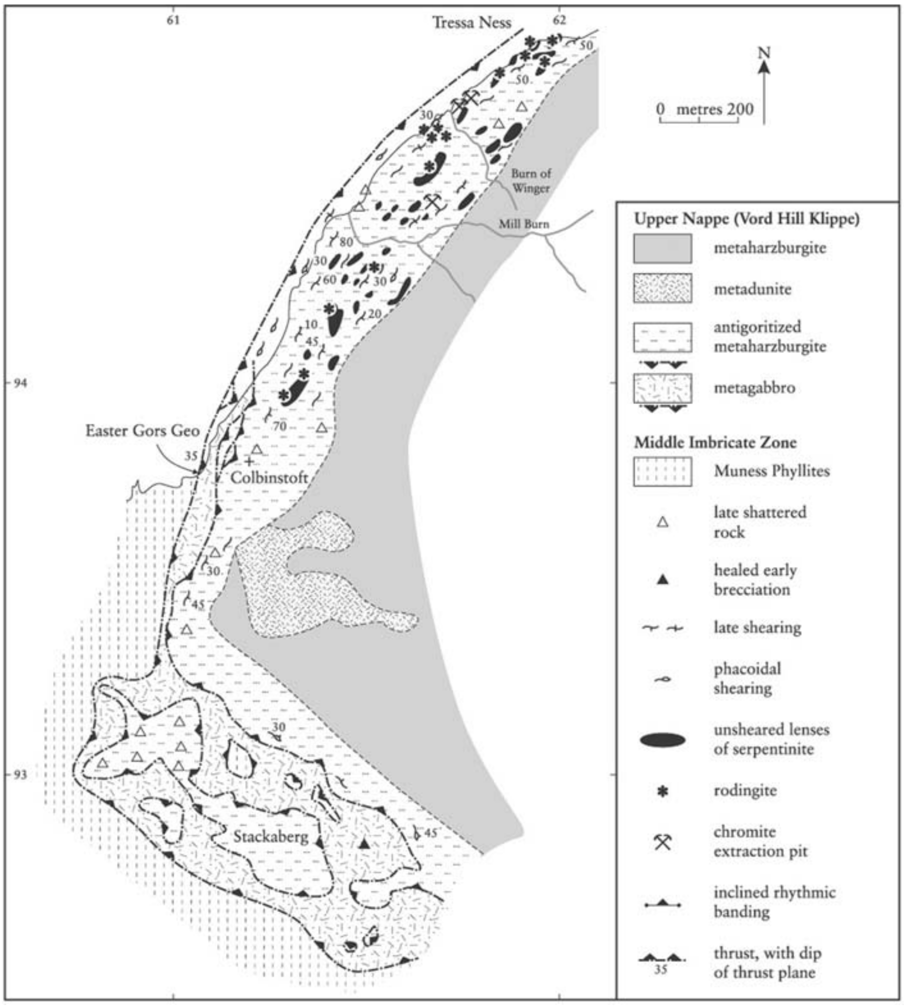

Figure 2.14: Map of the Stackaberg to Tressa Ness area, Fetlar.

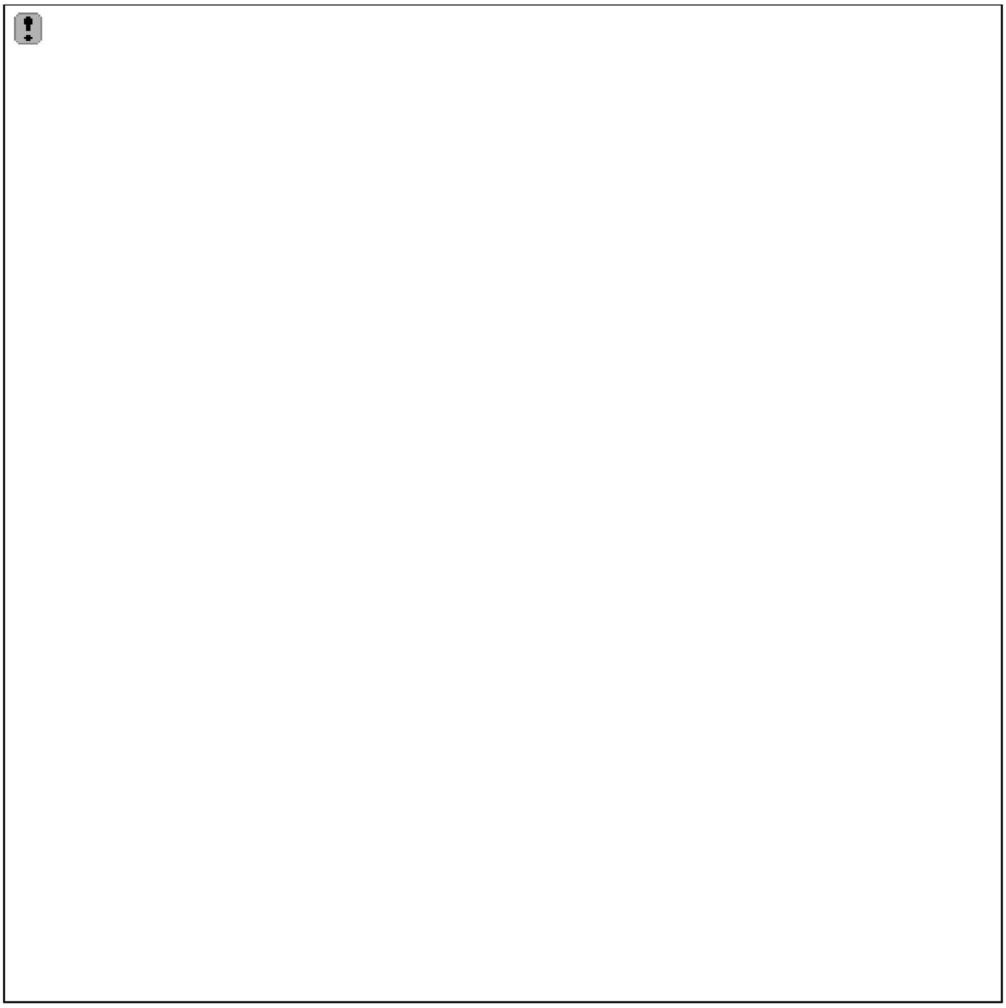

Figure 2.15: Tressa Ness from the south showing the sheared antigoritized harzburgite (dark colour) and the unsheared lenses of antigoritized dunite (light colour). (Photo: D. Flinn.)

In the coastal section the shear fabric is continuous; it strikes parallel to the coastline and dips variably to the east. The shear fabric varies in nature along the coast from a crudely parallel-spaced cleavage to a coarsely anastomosing foliation enclosing close-packed lenticles of serpentinite. Inland the rocks present much the same appearance, except that larger (up to 100 m long) lenses of non-schistose and unsheared serpentinite are there enclosed in sheared serpentinite indistinguishable from that along the coast.

On the coast south of Easter Gors Geo the thrust marking the base of the klippe runs inland from under the sea. It is steeply dipping and separates the overlying metaharzburgite of the klippe from metagabbro of lower metagabbro type. The metagabbro, in turn, overlies phyllitic metasedimentary rocks of the Middle Imbricate Zone exposed along the coast to the west. The base of the klippe and the underlying metagabbro slices can be traced up the hillside to the summit area of Stackaberg where the thrust becomes horizontal. On the summit of Stackaberg the metaharzburgite forms a group of irregular, closely spaced erosional remnants of the klippe resting on a tectonic sheet of metagabbro no more than a few tens of metres thick. In one place a window through the klippe and the underlying metagabbro reveals metasedimentary rocks of the Middle Imbricate Zone.

The most unusual lithological feature of the site is the presence of a number of rodingite bodies in the Colbinstoft to Tressa Ness area (Phemister, 1964). These are closely associated with large unsheared lenses of serpentinite enclosed within the schistosity or cleavage that dominates the base of the klippe. The rodingite occurrences are very irregular and ill-defined, vein-like bodies rarely more than a metre across in any direction. They grade continuously into the adjacent serpentinite, which has a similar greenish colour and surface texture. However, some, and especially the larger ones, have pink or even red cores due to the dominance of macroscopic garnet, for example at 6192 9487. The mineral content of the fine-grained, outer part of the veins can only be determined in thin section; diopside, epidote-type minerals, idocrase and chlorite are the principal constituents. The rodingite veins are not cut by the shearing associated with the base of the nappe. However, it is not clear if this is because the veins post-date the shearing or because they are protected by the unsheared lenses.

Interpretation

The unsheared lenses of serpentinite contained in the sheared base of the metaharzburgite klippe are formed of antigorite serpentinite derived from dunite (Phemister, 1964). Metadunite bodies of equidimensional, irregular and sheet-like form occur in the unsheared ochrous-weathering metaharzburgite nearby, but nowhere else in the Shetland Ophiolite are they more resistant to shearing than the enclosing metaharzburgite. The lenses weather white as a result of the complete antigoritization of the serpentine. In thin section they show no trace of serpentinized pyroxene, which is commonly visible in antigoritized harzburgite, and characteristically they contain more and slightly larger accessory chromite grains than would be expected of harzburgite.

According to Phemister (1964) the rodingite is the result of the metasomatic transformation of veins of gabbro (the protolith of the metagabbro) present within the ultramafic rock, by solutions from the cooling gabbro. He based this conclusion on the close proximity of the metagabbro with the serpentinite and the fact that in the whole of the Shetland Ophiolite rodingite only occurs where these two rocks are in contact. However, there are no ‘veins of gabbro' present and the nearby metagabbro is in tectonic contact with the serpentinite, not in igneous contact as concluded by Phemister.

Rodingite occurs in Shetland only in the base of the Upper Nappe in Fetlar, Unst and the island of Sound Gruney to the west of Fetlar. The rodingite veins have the appearance in the field and in thin section of being hydrothermal and metasomatic. They contain diopsidic clinopyroxene (very little Fe or Al), garnet (grossular 50% and andradite 43%), epidote minerals including zoisite and clinozoisite, prehnite, idocrase, chlorite and titanite (Phemister, 1964). According to Phemister (1964) ‘the transformation which resulted in the rodingites of Fetlar was induced by residual solutions from the gabbroic rock which were effective in carrying off Si, Al, and Na from the existing rock [gabbro] and possibly added Fe, Ca, and Mg'. Phemister's conclusions are similar to those in vogue today in other parts of the world for rodingite deposits associated with serpentinite (O'Hanley, 1996). However, it must be stressed that in Fetlar there is no evidence for the presence of gabbro veins in the base of the nappe and the gabbro was already consolidated and metamorphosed before it reached its present position below the serpentinite nappe, hence there is no clear gabbroic source of the metasomatizing solutions.Phemister (1964) also concluded that the rodingite veins were formed after the antigoritization (i.e. after the local, secondary serpentinization) and before the shearing of the base of the nappe. No definitive answer seems currently possible and the source of the Ca-rich metasomatizing solutions, the localization of the veins, and the timing of their formation are all problems waiting to be solved.

Conclusions

The Tressa Ness to Colbinstoft GCR site presents a remarkably well-exposed section through the base of the Upper Nappe. It illustrates the tectonics of emplacement of the nappe and the metamorphic and metasomatic processes that have taken place there to form rodingite deposits. The unusual characteristics of the latter provide one of the more enigmatic aspects of the Shetland Ophiolite. This adds to the value of the site since late-stage Ca-metasomatism is a widespread but poorly understood feature of many ophiolite complexes elsewhere in the world.

Reference list

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