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Ordovician(?) gastropods from cherts in Cretaceous sandstones, south-east Disko, central West Greenland

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Field work by AKP during 1984 on south-east Disko included a brief re-investigation of an unusual assemblage of clasts found in the Upper Cretaceous sandstones of the Atane Formation. These clasts were first found by Giesecke in 1807 (Giesecke, 1910) and subsequently briefly characterised by Schiener (1974, p. 25) as "a characteristic marker assemblage of ex-

otic components (acid subaerial volcanics, red and black cherts, pisolites and chertified limestones)". Schiener (1977) tentatively correlated the clasts with Early Cretaceous rhyolitic tuffs from Ivnakavsak on northern Nûgssuaq. Below, we briefly describe gastropods found in the clasts, as well as the clast lithologies. Several types of the chert clasts have begun to attract local interest as potential semi-precious stones.

The clasts

The clasts were investigated at a number of closely spaced localities on the south-east and east slopes of the mountain Tuapait qáqât (69°24'N, 52°40'W) on south-east Disko, where they occur concentrated in beds up to a few metres thick throughout the Cretaceous sandstones, from 50 to 270 m above sea level. The clasts range in size from less than 1 mm to about 6 cm. Lithologies include dominant rounded quartz, feldspar and aggregates of these minerals together with the 'exotic' assemblage. The latter includes andesitic to dacitic volcanic rocks, rhyolitic welded tuffs and lavas, siltstone and a wide range of silicified limestones of which many are pisolites. In addition, a varied assemblage of cherts is present. The cherts vary in colour from white to grey, green, brown, red, purple and black. Many are layered or concentrically banded whereas others are seen to replace existing sediment structures discordantly. A few cherts contain casts of a skeletal cubic mineral tentatively interpreted as former halite.

The gastropods

Gastropods occur in five collections and most specimens are preserved in tan to pale reddish brown, largely weathered chert. All the specimens are poorly preserved and generally lack any detail of shell ornamentation. The most notable specimens, following a preliminary examination, are two widely phanerомphalous, almost planispiral gastropods which have been sectioned approximately along the axis of coiling (GGU 327039, 327040). Characteristic of these is the low degree of whorl contact, the equidimensional whorl cross-section and a raised, acute flange along the upper, outer margin of the whorl. The unusual style of coiling and the acute flange are typical of ophiletinid pleurotomariins and some euomphalins. In particular, the Disko specimens invite comparison with *Ophileta* which is a characteristic genus from the Lower Ordovician of North America, although the Permian *Planotectus* is also very similar.

Other gastropods from the same locality at Tuapait qáqât include two high spired forms, one of which is reminiscent of several Palaeozoic murchisoniaceans and loxonemataceans.

A single specimen from GGU 327036 is a turbiniform internal mould with a somewhat gradate profile. The final whorl shows traces of growth rugae suggestive of a deep peripheral emargination. The latter feature may suggest assignment to the Pleurotomariina, but a number of genera within this suborder share this gross style of coiling. A single specimen, GGU 327037, is almost certainly a pleurotomariin, since traces of growth ornamentation on the internal mould delimit a peripheral band. The umbilicus is wide and open, and a muscle attachment trace is present on the umbilical shoulder.

A small loose block from Nunguaq, southern Disko, contains two poorly preserved, low spired internal moulds (GGU 327038). A second small block from the slopes below spot

height 467 m, near Skansen, Disko, contains very poorly preserved internal moulds and impressions of both low spired and high spired gastropods (GGU 157229).

Age of the fauna

All the available specimens are too poorly preserved to permit accurate identification. Indeed, most cannot be determined above the level of 'gastropod'. All the specimens are preserved in transported, redeposited cherts, making it far from certain that they share the same derivation or are of similar age. In consequence, any discussion concerning the age of the chert fauna can only point to possible sources, at this time.

The two widely phaneromphalous specimens from Tupait qáqât may suggest an age as old as Early Ordovician. A similar species, assigned to *Ophileta,* is known to occur in the lower part of the Wandel Valley Formation of North Greenland, in strata of late Ibexian (late Early Ordovician age). These specimens occur as silicifications associated with cherts (JSP, unpublished observation). Ordovician strata are known to have occurred in southern West Greenland as cover to the Precambrian crystalline basement. Their remains are present in the form of detrital deposits at 'Fossilik' with blocks of limestone and dolomite (see Peel, 1982, for summary). Conodont studies of these blocks, in progress, indicate strata of Early, Middle and Late Ordovician ages (M.P. Smith, personal communication) and similar sequences are described from adjacent Baffin Island and Melville Peninsula, Canada (Sanford, 1977). Thus, eventual identification of the Disko specimens as *Ophileta* gains a measure of support from the Ordovician relics in southern West Greenland. The similarity with *Planotectus,* a Permian genus, lacks such direct support, since strata of this age are not known from the region. Croxton (1979), however, noted reworked palynomorphs of possible Carboniferous age from the Kangâmiut 1 well, offshore West Greenland.

The other gastropods offer little direct indication of age, other than a general determination of Late Cambrian or younger. It is clearly premature to suggest a source for the varied Disko chert pebbles, but the possibility that at least some of them could be as old as Ordovician is an intriguing speculation.

Regional implications

The clast assemblage occurs throughout southern and eastern Disko (Schiener, 1974) in clastic sediments which persistently show derivation from the south and south-east (Schiener, 1975). The possible Lower Palaeozoic (Early Ordovician?) age for at least some of the clasts suggests that they were derived, as the most erosion resistant elements, from a widespread sequence of Palaeozoic platform sediments, although volcanic rocks were also present. It would appear that this cover of Palaeozoic sediments was extensive as the relic Ordovician from 'Fossilik', noted above, lies some 400 km to the south. Ordovician strata similar to those known from 'Fossilik' occur in Baffin Island and Melville Peninsula (Sanford, 1977), although the lithologies are also typical of Ordovician sequences in North Greenland.

Fossiliferous blocks of sediments are also known from an intermediate locality, Sarfartoq (Secher & Larsen, 1978; Peel & Secher, 1979). Recent age determinations of the carbonatite associated with Sarfartoq sediments indicate an age of 600 ± 20 Ma (Larsen *et al.*, 1983). The

relationship between the carbonatite and the silicified and baritised fossiliferous sediments is problematic and may involve a post-intrusive, karstic phase and late stage hydrothermal activity. The age of the fossils is uncertain, but they could be as old as Early Cambrian.

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Investigation of the Qaqarssuk carbonatite complex, southern West Greenland

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During the summer of 1984 the Qaqarssuk carbonatite complex was visited as a part of the EEC supported project 'Apatite Mineralisations in Carbonatite and Ultramafic Intrusions in Greenland'. The complex is situated 60 km east of Sukkertoppen and was originally found and mapped by Kryolitselskabet Øresund A/S (Vuotovesi, 1974, and Gothenborg *et al.*, 1977).

The field work in 1984 was focussed on geological mapping of the complex (on 1: 10 000 orthophoto map), and on geophysical mapping of the thickness of the overburden (described by Kjærgaard & Olsen, this report). Collection of soil samples was carried out in order to evaluate a possible residual soil cover as a source for phosphorous and niobium. Apatite and REE mineralised rocks were also sampled for beneficiation studies.

Geological setting

The Archaean basement, consisting of granitic to tonalitic gneiss and amphibolite, was intruded by the carbonatite 170 Ma ago (Larsen *et al.*, 1983). A 5–20 m thick, north–south trending norite dyke and several minor dolerite dykes are also cut by the carbonatites.

The almost rectangular shape of the complex (fig. 9) is controlled by the regional fracture systems: 040–050° and 130–150°. The carbonatite intruded as steep concentric sheets varying in thickness from a few centimetres to several tens of metres. The carbonatite sheets in the central part of the complex are thicker than the outer sheets, and the sheets swell near the 'corners' of the complex. The carbonatite sheets dip steeply outwards in the major part of the area, but in the north-west part at a low altitude, the sheets dip inwards. This indicates that the carbonatite sheets are slightly curved, giving the complex an onion-like shape (fig. 10). The sheets contain varying amounts of fenite inclusions, and the carbonatitic rocks range from homogeneous, pure carbonatite sheets to carbonatite seen in a braided pattern between fenite lenses. Hence it has been necessary to use arbitrary boundaries (at 50% carbonatite) in the mapping of the complex (fig. 9).

The fenite

The carbonatite complex is surrounded by a fenite aureole, as indicated on fig. 9. The degree of fenitisation decreases away from the individual carbonatite sheets, and the most altered/fenitised rock – the fenite proper – has lost all quartz and consists of feldspar (predominantly albite), alkali amphibole and alkali pyroxene. Where the basement is extremely fenitised, or where the composition before fenitisation was mafic, the rock may be changed to ultramafic rock types such as hornblendite or glimmerite. Both the mineralogy and the texture of the fenite are totally reworked. The fenite is often foliated, with mafic and feldspathic schlieren parallel to the adjacent carbonatite sheets.