Indication of migrated hydrocarbons in Tertiary volcanic rocks from western Nûgssuaq, central West Greenland

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During the field season of 1985 the author briefly visited Marrait kitdlît at the southern part of the entrance to the Itivdle valley on Nûgssuaq (fig. 1). This paper briefly describes the occurrence of possibly migrated organic material in a vein in Tertiary basalt and presents it in a regional context.

Regional geology

The Marrait kitdlît area has been mapped in some detail (Henderson, 1975) and is well known for its few metres thick calcareous fossiliferous conglomerates (Hansen, 1970; Rosenkrantz, 1970; Jürgensen & Mikkelsen, 1974), and for its hydrothermal veins (Karup-Møller, 1969; Binzer & Karup-Møller, 1974). A sequence of hyaloclastites and minor fossiliferous conglomerates is overlain by picritic and olivine-poor basaltic lava flows, all belonging to the early Tertiary Vaigat Formation. Later faulting has cut the volcanic pile into blocks which are downthrown by about 0.5 to 1 km compared to a stable plateau 5 km to the east. Scattered exposures of Cretaceous to early Tertiary marine mudstone with intercalated sandstone occur in the Itivdle valley and represent the pre-volcanic substratum (Henderson *et al.*, 1976). West of the Itivdle valley a sequence of basalts at least 3 km thick from the Maligât Formation, which overlies the Vaigat Formation, is exposed (Hald, 1976) suggesting that the investigated locality at Marrait kitdlît was once covered by several kilometres of volcanic rocks. A major NE–SW striking fault zone extends from the southern tip of Hareøen through the Itivdle valley to Umanak Fjord over a distance of at least 60 km (fig. 1). Associated with this fault zone is the largest known palaeo-hydrothermal high-temperature area in the Tertiary volcanic province of West Greenland. The high-temperature hydrothermal zone is observed on the southern part of Hareøen as local fossil hot spring areas where basaltic lavas and tuffs are altered to crumbling white and grey masses, and in Itivdle as areas of hydrothermally metamorphosed lavas and hyaloclastites which may locally contain epidote. The degree of metamorphism in these areas exceeds by far the regional non-penetrative low zeolite facies metamorphism which characterizes the volcanic lithologies elsewhere in the Disko–Nûgssuaq region.

Hydrothermal vein

A hydrothermal vein is exposed over a distance of a few metres in the Marrait kitdlît area on the southern flank of a NW–SE trending ridge just west of Tufdalen about 50 m southwest of the main fossiliferous conglomerate at Tufdalen (loc. 2 in Binzer & Karup-Møller, 1974). The vein, which cuts through olivine-poor subaerial basalt lava flows, is about 10 cm thick and consists of aggregates of centimetre-sized carbonate crystals. In the inner part of the vein are cavities which are partly filled by a loose black granular powder (fig. 2). The

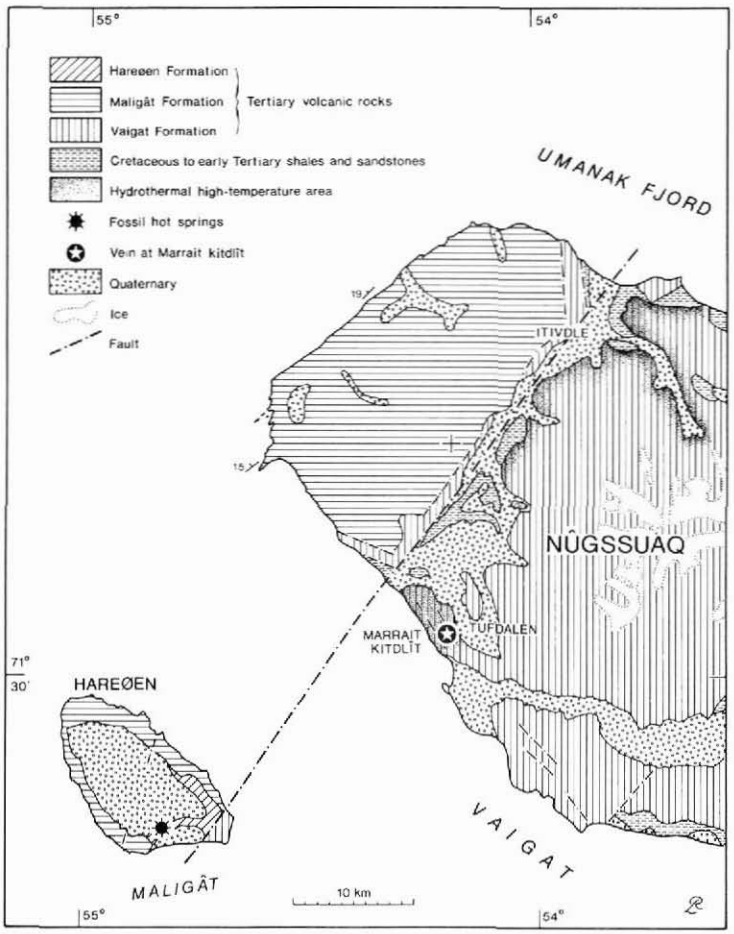

Fig. 1. The western Nûgssuaq and Hareøen region with the prominent Itivdle-Hareøen fault system, which is thought to be a part of the major NE–SW trending transform fault system in Baffin Bay formed at anomaly 20 to 24 time (e.g. Menzies, 1982). Hydrothermal high-temperature areas in the Itivdle valley and the fossil hot springs at Hareøen are shown.

'powder' consists of from < 0.2 to 1 mm grains of clay coated by a black substance which also coats parts of the carbonate crystals of the cavity walls.

A cursory examination of cleavage fragments of the carbonate has revealed the presence of aqueous liquid-vapour inclusions (degree of filling about 0.95) with salinities around two equivalent weight % NaCl. No hydrocarbon-bearing inclusions were found (J. Konnerup-Madsen, personal communication, 1985).

A sample of the clay granules (GGU 279075) has been analyzed for total carbon (TC) and 'total organic carbon' (TOC) and a Rock Eval analysis has been carried out by the source rock laboratory of DGU and GGU. The sample contains 1.30 wt.% TC and 1.18 wt.% TOC and the hydrocarbons are completely degraded, probably by thermal alteration. The 'or-

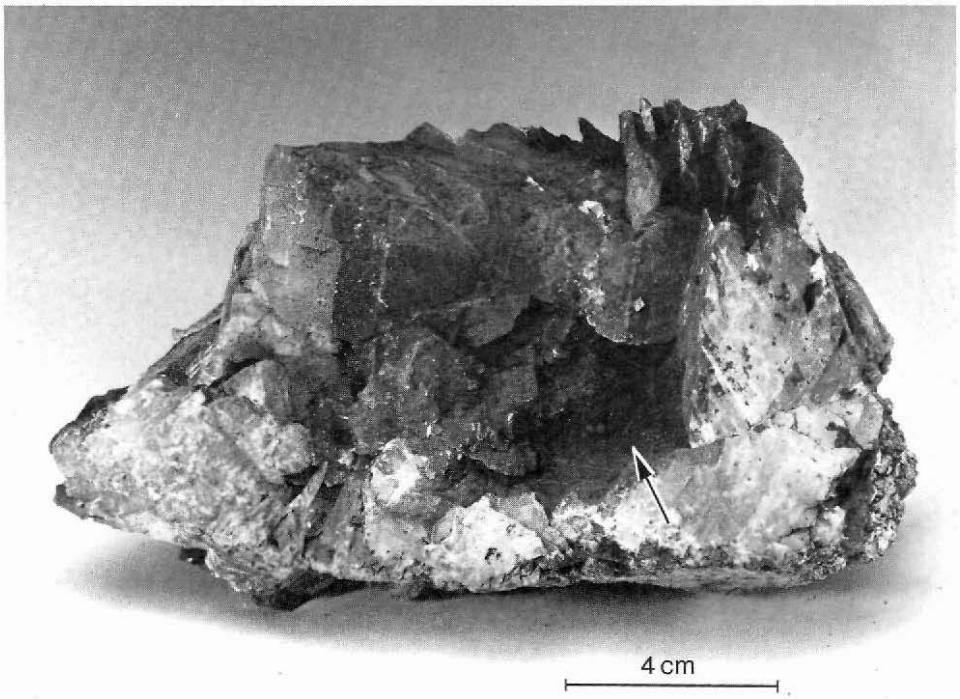

Fig. 2. Carbonate vein with cavities partly filled by clay substance coated with black degraded organic material, sample GGU 279076 from Marrait kitdlît. Sample 279075 was taken from the cavity shown by the white arrow. Photo: O.B. Berthelsen.

ganic carbon' presumably occurs as the thin black coating which must have precipitated from a fluid phase.

Implications

The oil and gas potential of the Cretaceous to Early Tertiary shales in West Greenland has been assessed by Henderson (1969), Schiener & Leythaeuser (1978), Perregaard (1979) and Henderson *et al.* (1981). Generally, the sediments are characterized by thermally immature organic matter. Exceptions are contact zones to Tertiary igneous intrusive bodies and the Itivdle fault zone. Perregaard (1979) noted the presence of elevated maturation levels in oil source rocks in Upper Cretaceous/Paleocene shales in the Itivdle area.

The present example shows that hydrocarbons have migrated vertically at least 500 m upwards into Vaigat Formation volcanic rocks within the Itivdle-Hareøen fault zone. A former high-temperature hydrothermal zone extends for at least 8 km across the fault system and it is likely that at least several hundred square kilometres (and probably much more) within the Itivdle-Hareøen fault system have been affected by the hot hydrothermal solutions. Consequently, organic matter in a considerable volume of shale, both onshore and offshore in the area, could have generated hydrocarbons.

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