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Preliminary notes on new copper and manganese occurrences in the northern Oman Mountains, northwest of Al-Fujairah, United Arab Emirates

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ABSTRACT

This paper reports the discovery of copper and manganese occurrences in the northern Oman Mountains within the gabbroic rocks of the Semail ophiolites and the underlying metamorphic sheet. Three copper occurrences were located, one in the schists and two in the layered gabbros. In all these occurrences, Cu minerals are concentrated in linear shear zones. Widespread bleaching of the gabbro seems to be associated with the mineralisation. The Cu deposits are considered to be of epigenetic hydrothermal origin. Massive manganese minerals, dominantly braunite, occur in the form of thin laminae or thick layers interbedded with chert and calcareous rocks of the metamorphic sheet. These bands are considered to have originated in deep water and to have been recrystallised during the metamorphism of the enclosing rocks.

INTRODUCTION

The Oman Mountains include one of the largest ophiolites in the world, the Semail nappe. Here, a complete ophiolite sequence is present. In the northern part of the mountains, within the territories of the United Arab Emirates (UAE), two units of this sequence crop out, the peridotites and the gabbroic rocks (Fig. 1). A succession of metamorphic rocks also occurs in limited outcrops and forms a sheet at the base of the ophiolites. The ophiolites and the metamorphic sheet are separated by a major thrust plane.

The general geology of the Oman Mountains has been discussed by many authors, e.g. Lees (1928), Morton (1959), Tschopp (1967), Wilson (1969), Reinhardt (1969), Allemann & Peters (1972), Glennie *et al.* (1974), Welland & Mitchell (1977) and Gealey (1977). However, the mineral resources have not been considered by these authors. Greenwood & Loney (1968) published data concerning the mineral resources in the UAE part of the Oman Mountains, whereas Smewing *et al.* (1977) reported the occurrence of Cu-mineralisation in Sohar, Sultanate of Oman, about 100 km south of Al-Fujairah. This paper reports the discovery of new sites for copper and manganese mineralisation in Al-Fujairah (Fig. 1).

COPPER MINERALISATION

Three sites of copper mineralisation have been discovered within the study area (Fig. 1),

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one within the metamorphic sheet and two in the layered gabbros of the Semail ophiolites.

In the first site, the schists were intensely sheared and fractured with the development of several mineralised shear zones up to 3 m wide. These zones have a general trend of N 70° E, with steep dips (65° or more) to the SE (Plate 1). The largest of these shear zones is well exposed in a road cut along the main Al-Fujairah highway about 1·5 km NW of Bulaydah. In this road cut, abundant secondary copper carbonates occur. The sheared rocks are lavishly impregnated by reddish, brownish and yellowish iron oxides and hydroxides (Plate 2). Gossans mark the horizontal extension of mineralised zones, whereas veins and encrustations of secondary copper minerals are quite common in the schists which surround the shear zones. These schists

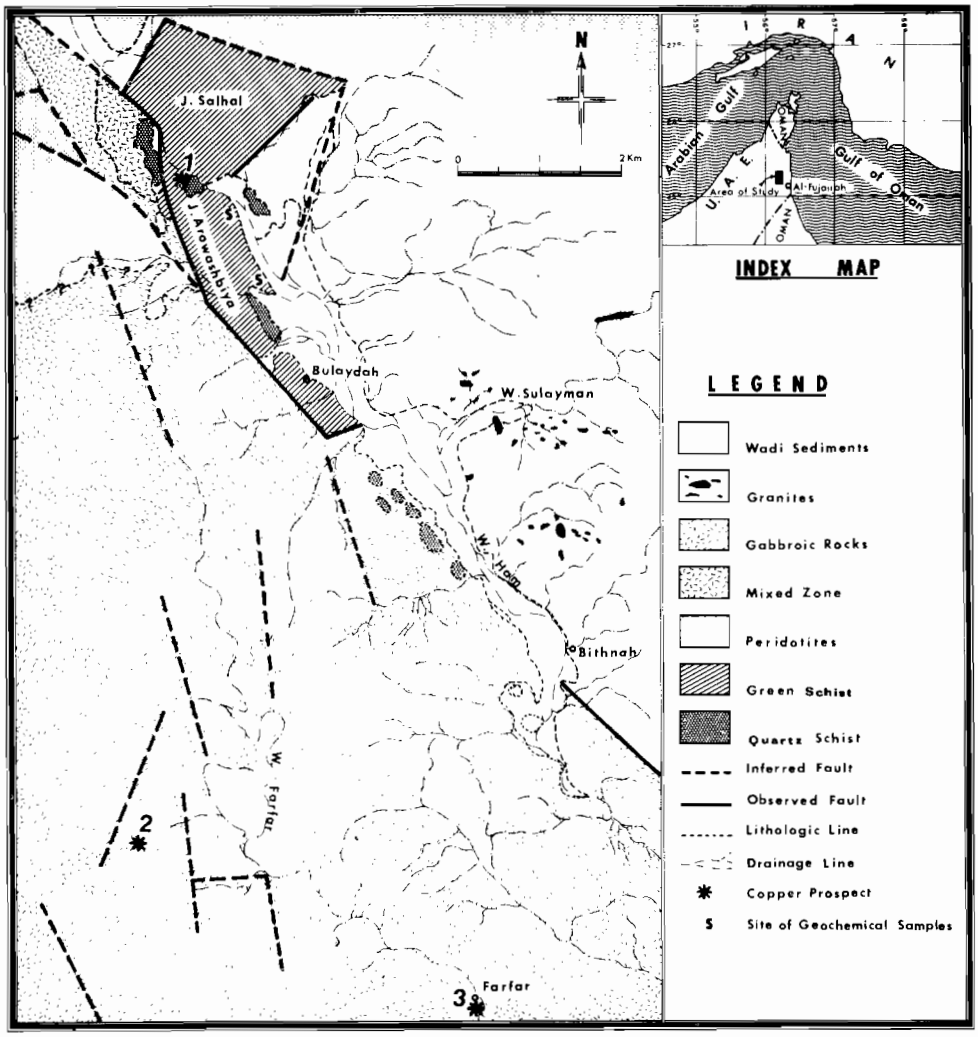

Fig. 1. A geologic map of the area NW of Al-Fujairah, UAE , showing the sites of copper mineralisation.

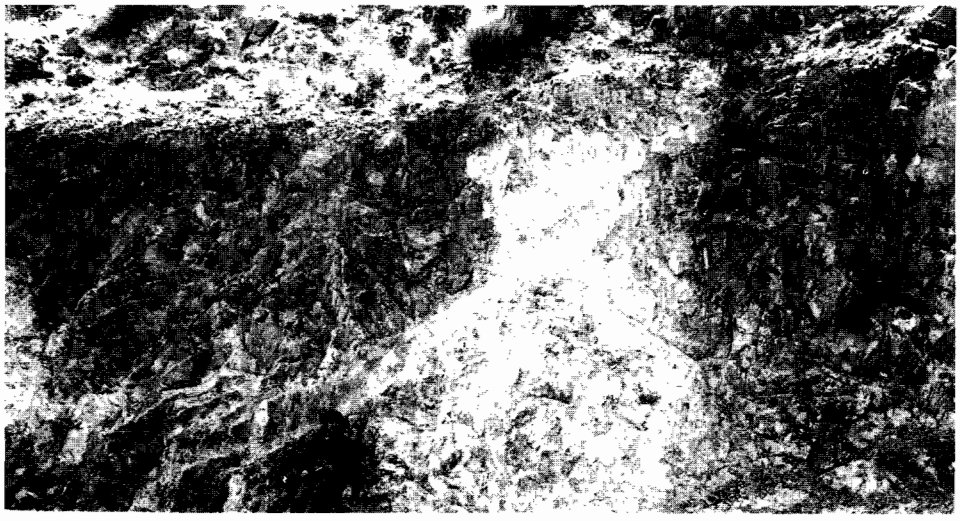

Plate 1. A fracture zone in the schists of copper Site No. 1, about 1·5 km NW of Bulaydah.

Plate 2. Oxidised cap rocks in the main shear zone of copper Site No. 1 exposed by road excavation in the schist, about 1·5 km NW of Bulaydah.

are mainly in the greenschist facies grade. They are mostly greenish in colour, but some are reddish in colour due to ferrugination.

The second site of copper mineralisation occurs in the layered gabbros (Fig. 1). Road excavations cut through about 1 km of fractured gabbro, which is intensely altered and bleached. Patches of whitish altered gabbro could be seen for a distance of about 4 km in a northward direction and probably define the extension of the fracture zone. The altered areas are crossed by richly mineralised fracture zones up to 30 cm wide with brown–yellow stained sheared selvage zones. In these fracture zones, moderately fresh gabbro that seems to have escaped the widespread alteration and bleaching, is present. The general trend of these zones is N 5° E with steep dips (70° or more) to the east (Plate 3). The secondary copper minerals are only found within the

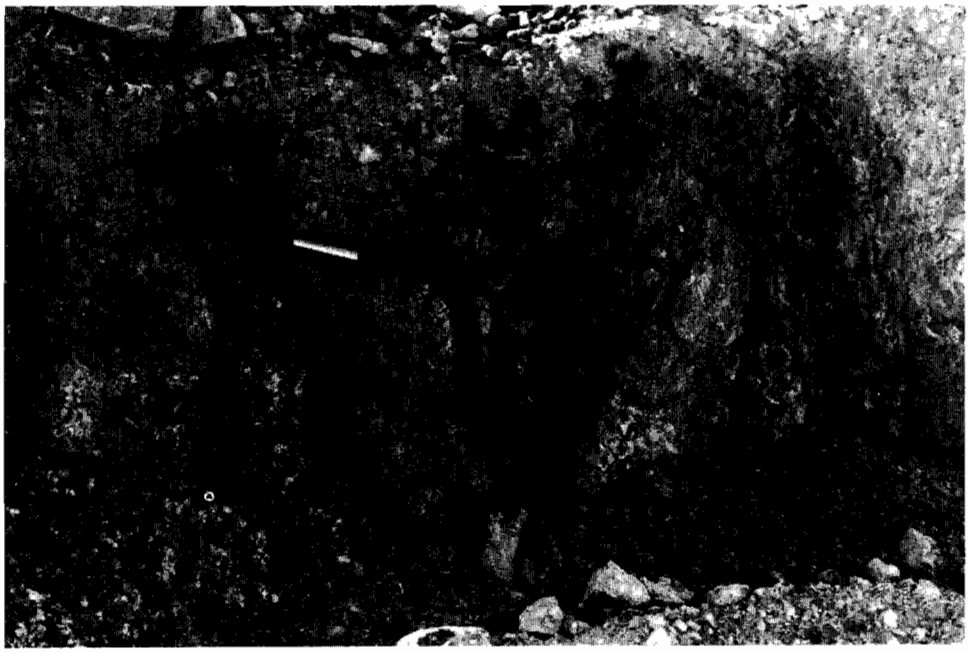

Plate 3. Bleached gabbro of copper Site No. 2 with narrow mineralised fracture zones, about 3 km SW of Bithnah.

fracture zones associated with moderately altered gabbros. But within the intensely altered and bleached rocks which occur between these fracture zones, copper minerals are completely absent. This may indicate that the deposition of copper minerals in the fracture zones took place before the alteration. The mineralised zones were not affected by alteration because they were made impermeable to the altering solutions by the deposition of the ore.

The third site of copper mineralisation occurs also in the layered gabbro, about 6 km SE of the second site (Fig. 1). In this site, the layered gabbros are deeply bleached and turned into a whitish friable rock 300 m wide and extending for about 1·5 km in a N–S direction (Plate 4). Linear gossans are quite common within this alteration zone (Plate 5) and contain abundant specks of secondary copper minerals. Away from the gossans, Cu-minerals are absent. By comparison with Site 2, these gossans most

Plate 4. A zone of bleaching in layered gabbro about 5 km SW of Bithnah (copper Site No. 3).

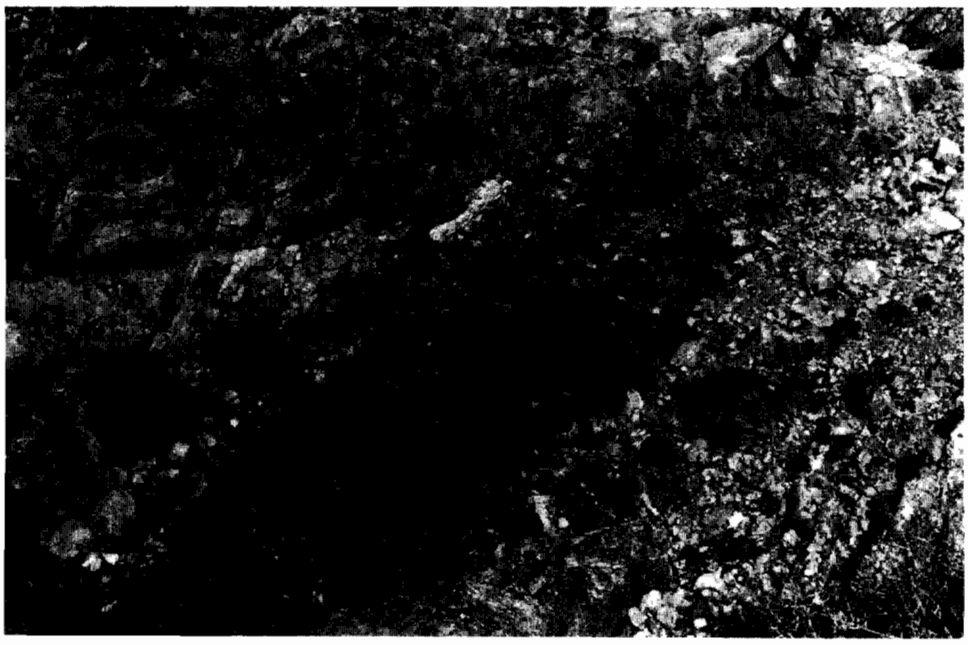

Plate 5. A gossan in copper Site No. 3, about 5 km SW of Bithnah.

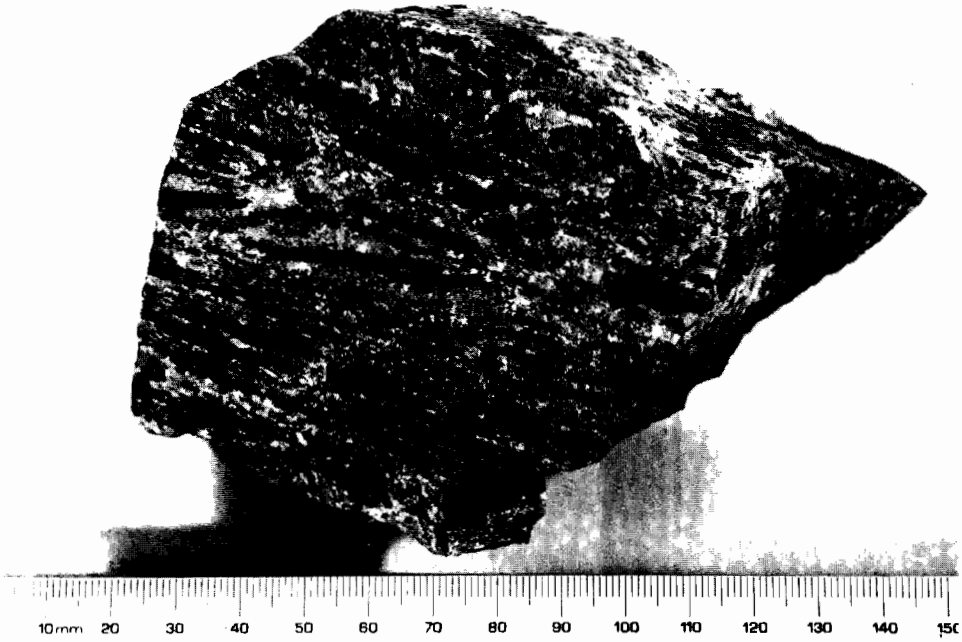

Plate 6. Fine managenese bands interlayered with chert, about 2·5 km NE of Bulaydah.

Plate 7. Massive managanese bands in the same occurrence as Plate 6.

probably represent the caps of mineralised zones similar to those observed in the second site.

In the surroundings of the copper sites, bleaching is very common in the gabbro. However, no signs of copper mineralisation were found in these bleached parts. But in areas where the gabbro is sheared without being bleached, specks of secondary copper minerals are abundant. The analyses of some samples from the mineralised schists and gabbros (Hassan & Al-Sulaimi, in preparation) show anomalous concentrations of As, Se, Sb and U. One sample contains 4·5 ppm silver. The high content of As in two gossan samples from the second site (6,500 ppm and 2,700 ppm respectively) may indicate the presence of gold in extractable amounts.

The common occurrence of gossans and oxidised cap rocks in the mineralised areas indicate that the mineralised shear zones have been subjected to weathering and leaching. This suggests the possibility of the occurrence of supergene enrichment zones at depth. It is believed that the copper deposits are of epigenetic hydrothermal origin. The primary copper minerals were deposited as disseminated grains and small veinlets within fracture zones. Mineralisation and bleaching (probably kaolinisation) may have been caused by the same agents, but they were separated in time, mineralisation being the earlier process. This is supported by the fact that the copper mineralisation occurs only in non-bleached gabbro in shear zones. These mineralised shear zones occur within bleached gabbro which does not show any signs of mineralisation.

MANGANESE MINERALISATION

In the southern part of Gabal Salhal, about 1 km due east from copper Site 1, laminae and layers of massive manganese minerals occur interbedded with metamorphosed cherts and calcareous greenschists within the metamorphic sheet underlying the Semail ophiolite. The manganese minerals occur either as fine intricate intercalations with fine cherty and calcareous layers (Plate 6), or as thick massive and well-defined layers up to 50 cm in thickness (Plate 7). The manganese layers are hard, dense and black in colour. They are composed mainly of massive aggregates of braunite and are considered to have been deposited in deep water together with the enclosing sediments. Recrystallisation of the manganese layers took place during the metamorphism of the sediments.

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ملاحظات أولية عن مواقع جديدة للنحاس والمنجنيز بشمال جبال عمان شمال غرب الفجيرة ، الامارات العربية المتحدة

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خلاصة

تسجل هذه الملاحظات اكتشاف مواقع جديدة لتواجد النحاس والمنجنيز في شمال جبال عمان في الصخور الجابروية لاوفيوليت سماعيل والصخور المتحولة الواقعة تحتها . وقد تم تحديد ثلاثة مواقع للنحاس ، واحد منها في الشست واثنان في الجابرو الطباقي . وفي المواقع الثلاثة تتركز معادن النحاس في أحزمة تهشم طولية . وقد صاحبت هذا التمعدن تغيرات واسعة النطاق في الجابرو . وتتواجد معادن المنجنيز التى تتكون أساسا من البراونيت على هيئة رقائق أو طباقات تتخلل طباقات الصوان والشست ضمن الصخور المتحولة في أسفل افيوليت سماعيل . وقد اعتبرت رقائق وطباقات المنجنيز ذات أصل رسوبي مثل الصخور التى تحتويها .

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