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Micro-textures of Hematite in the Liesegang Rocks, Found in Pyrophyllite Deposits, Shobara District, Southwest Japan.

By

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with 18 figures

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Abstract: Characteristic micro-textures of hematite found commonly in the Liesegang rocks collected from pyrophyllite ore deposits, Shobara district, southwest Japan were investigated. Detailed observations of the Liesegang rocks under the high magnification reflection microscope with oil immersion lens reveal that almost all of opaque grains are composed of needle-shaped very fine crystals with less than few microns in width and 5-10 microns in length. Moreover, doughnut-like texture, which is characteristic in the Liesegang rock (Yamashita et al., 1996), is mainly composed of the needle-shaped fine crystals. In many cases, the rings are composed of radiated aggregates of the needle-shaped hematite crystals. The size of the most predominant rings is less than 10μm in diameter, and double, triple and multi rings are also common.

The optical properties of these opaque crystals under the reflection microscope are almost similar to those of ordinary hematite, i.e., weak but noticeable bireflectance and distinct anisotropism (e.g., Uytenbogaardt, 1971). X-ray powder diffraction data indicate that most of the opaque minerals are hematite with small amount of goethite. However, under the reflection microscope, distinguishment of the two minerals is not possible.

Introduction

Beautifully developed Liesegang textures are commonly found in pyrophyllite ore deposits in Shobara district, southwest Japan and a photograph collection of the textures is already presented (Yamashita et al., 1996). The Liesegang texture is characterized by alternate of light and deep color bands. These bands have various colors such as brown, purple, red and gray. Hematite is one of the most common constituent minerals in the deep color bands as well as pyro-phyllite, sericite and quartz.

Detailed observation of the polished specimens of these rocks under the high magnification reflection microscope using oil immersion lens reveals characteristic textures of opaque crystals.

X-ray powder diffraction patterns indicate that hematite is the most predominant but existence of small amount of goethite is also recognized. However, under the reflection microscope, distinguishment of the two minerals is not successful. According to Ramdohr (1969), needle-shaped morphology of the present opaque mineral is more similar to that of goethite than that of hematite. Platy habits without tip nature, however, suggest that the mineral is most probably hematite.

The main purpose of the present paper is to present characteristic micro-textures of the opaque minerals. Distinguishment between hematite and goethite is remained to be established.

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Description of hematite

In the deep color part of Liesegang texture, hematite grains with less than about 100 μm are disseminated and the most predominant size of the grains is about several microns. The doughnut hematite generally occurs in the central region of the deep color part. Moreover, when the doughnut hematite is present, about 500 μm^2 area around the doughnut is almost free from disseminated hematite (Fig. 1). Even around distorted hematite ring, disseminated hematite is also rare . The shape of the rings is regular circle in the middle region of the deep color part and towards the light color part, ring becomes more and more oval, i.e., irregular circle and ellipse to even amoeba-like shapes (Fig. 2).

In the light color part, small grains of hematite less than about 10 μm in size are sporadically disseminated (several grains in the area of 500 μm^2. Fig. 3). Concentration of hematite grains characteristically occur around pyrophyllite (or sericite) grains.

Under the high magnification reflection microscope using oil immersion lens, central core of the doughnut hematite is composed aggregates of needle-shaped crystals and the size of each crystal is less than 1 μm in width and 5 μm in length (Fig. 4). The outer ring is also composed mainly of needle-shaped hematite. The needle-shaped hematite is in some cases arranged radially (Fig. 5). This tendency is also recognizable in the third and more outer hematite rings (Fig. 6).

Examination of polished sections both perpendicular and parallel to the Liesegang bands indicates that no special arrangement and no preferred orientation of the fine crystals to the flow plane of the host volcanic rocks are recognized.

The shape of the hematite rings (doughnut hematite) is variable and the following variations are observed.

1) Double ring A : The central core is composed of aggregation of radially arranged fine needle-shaped crystals. The outer ring is also composed of radially arranged fine crystals (Fig.7-1). In some cases, radial arrangement of the fine crystals in the outer ring is not clear (Fig. 7-2).

2) Double ring B : The central core is also composed of fine needle-shaped crystals but orientation of the fine crystals is rather variable (Fig.7-3).

3) Double ring C : The central core is composed of one or two relatively large needle-shaped crystals (10 μm in length). In this case, the outer ring is not complete as shown in Fig.7-4. As the variation of this type, rings with the central core composed of radially arranged relatively large crystals are also present (Fig.7-5). The outer rings are generally intermitted and not complete.

4) Single ring without hematite core : Fig.7-6 shows typical simple ring. The ring is composed of a) radially arranged fine needle-shaped crystals (Fig.7-6), and b) arranged in random orientation (Fig.7-7).

All of these ring textures are commonly observed in the deep color part.
Coalescence of the rings is commonly observable. That is, in the extreme case more than ten rings coalesce with each other showing petal-like form (like botryoidal hematite (Ramdohr, 1969, Fig. 617a). Fig. 8). High magnification observation of the disseminated hematite grains larger than about 50 μm in deep color parts shows that the grain is composed of rings with about 10 μm in diameter, and each ring is composed of very fine grained needle-shaped crystals with less than 1 μm in width and several μm long. Moreover, these crystals are often arranged radially (Fig. 9). In the deep color part, hematite grains of about 10-20 μm are often observed and each grain is composed of very fine grained needle-shaped hematite crystals (Figs. 10 and 11). In the light color part, size of the hematite grains is rather small (mostly less than 10 μm in diameter) and hematite occurs relatively rare compared with in the deep color part. Doughnut hematite is very rare and the shape of the rings is significantly distorted. In general, inside of the ring distinct internal reflection with reddish brown color, suggesting the existence of hematite or hematite-analogue, is observed (Fig. 12). Among the doughnut hematite, rings with obscure center are often observed. In such cases, strong internal reflection of reddish to brownish red color is characteristic.

The optical properties of these fine needle-shaped hematite under the reflection microscope are almost same to those of the doughnuts, that is, hematite characterized by noticeable bireflectance and strong anisotropy with grayish blue to grayish tint yellow (Uytenbogaardt and Burke, 1971).

References

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Uytenbogaardt, W. and Burke, E.A.G., 1971: *"Tables for microscopic identification of ore minerals."*, Elsevier Scientific Publishing Company, Amsterdam.

Explanation of figures

Fig. 1 Doughnut hematite. Note that the area around the doughnut is almost free from hematite.

Fig. 2 Irregular ring found close to the light color part.

Fig. 3 Disseminated hematite grains in the light color part.

Fig. 4 In the light color part, the rings are usually distorted. The central core is composed of needle-shaped relatively large hematite crystals.

Fig. 5 Radially arranged hematite crystals in the central core.

Fig. 6 Multi-rings. Note that hematite crys-tals are arranged radially especially in the outer rings.

Fig. 7-1 Double ring. A: The central core is composed of radially arranged fine crystals.

Fig. 7-2 Double ring. A: Radial arrangement of the crystals in the outer ring is not clear.

Fig. 7-3 Double ring. B: Note that orientation of fine crystals in the central core is not clear.

Fig. 7-4 Double ring. B: The central core is composed of several relatively large crystals. Note that the outer rings are intermitted and not complete.

Fig. 7-5 Double ring. C: The central core is composed aggregates of relatively large crystals and the outer ring is intermitted and not complete.

Fig. 7-6 Single ring. Note that fine crystals are arranged radially.

Fig. 7-7 Single ring. Radial arrangement of fine crystals are not clear.

Fig. 8 Coalescence of rings showing petal-like form similar to botryoidal hematite (Ramdohr, 1969).

Fig. 9 Disseminated hematite grains more than about 50μm in size are aggregates of rings composed of very fine needle-shaped crystals.

Fig. 10 Hematite grains composed of very fine needle-shaped crystals.

Fig. 11 Coalescence of hematite rings composed of fine needle-shaped crystals.

Fig. 12 Internal reflection with reddish brown color, observed in the hematite rings.

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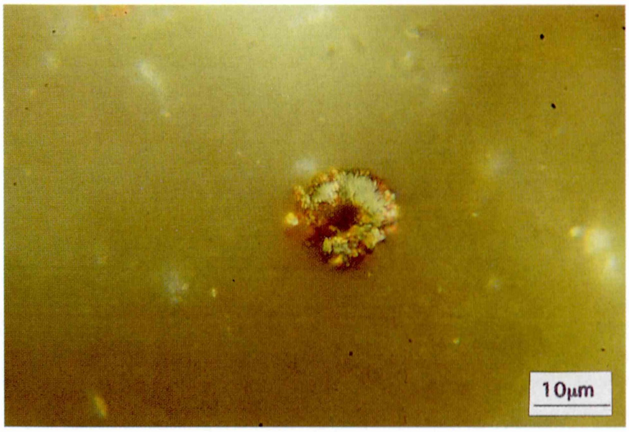
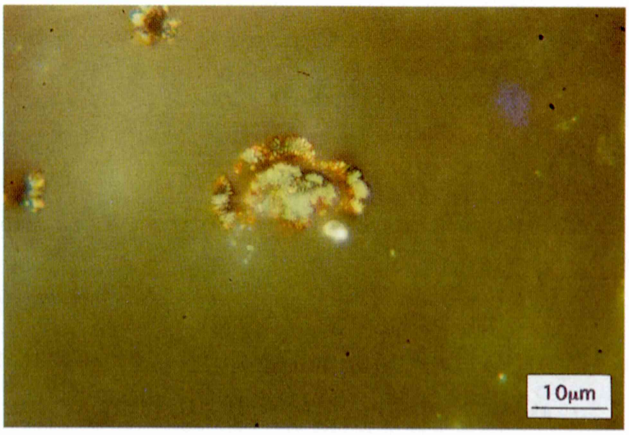


Fig. 1.



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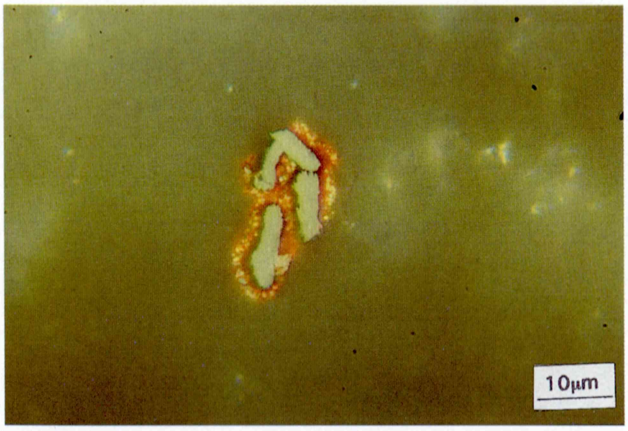

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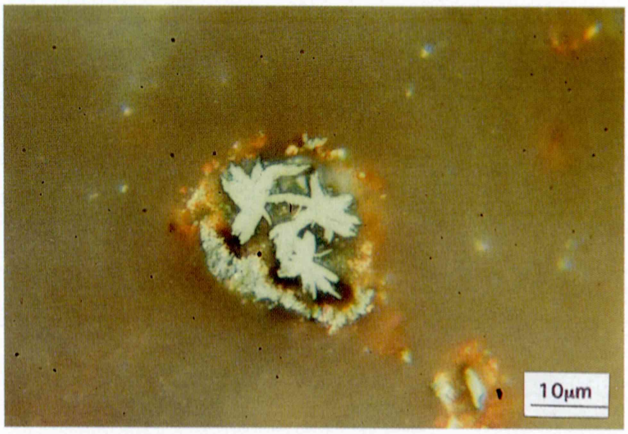

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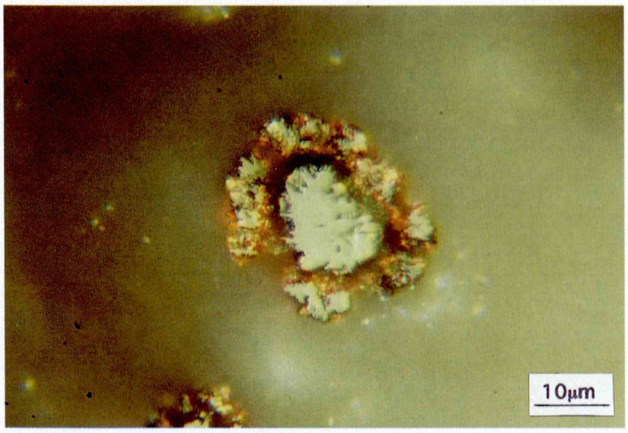

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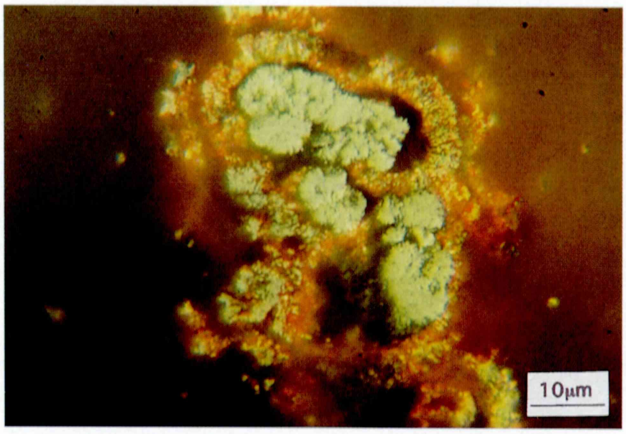

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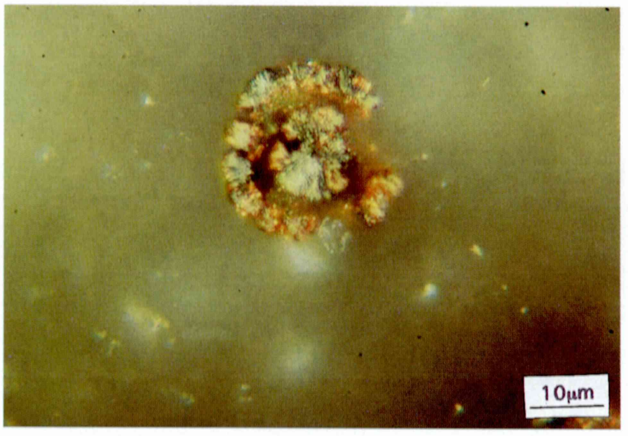

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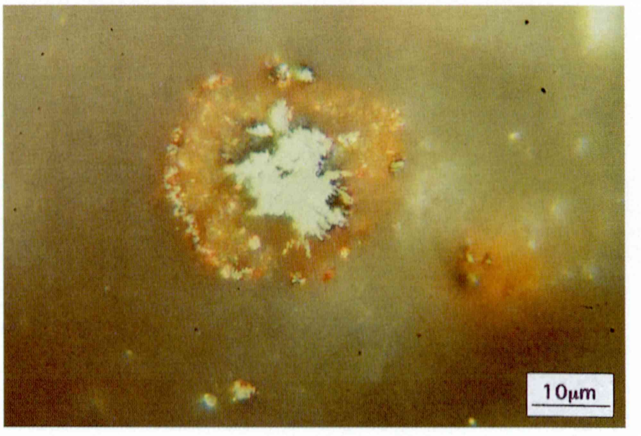

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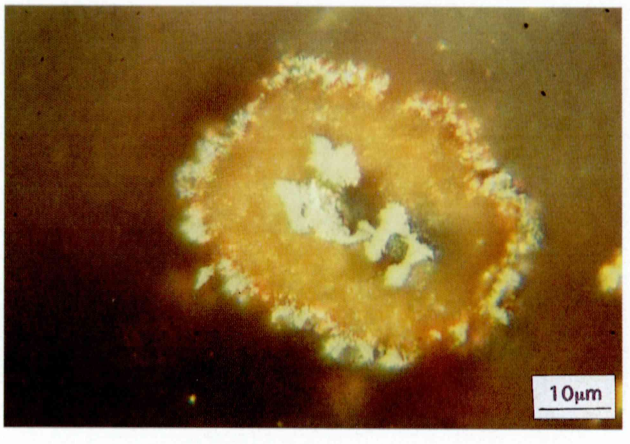

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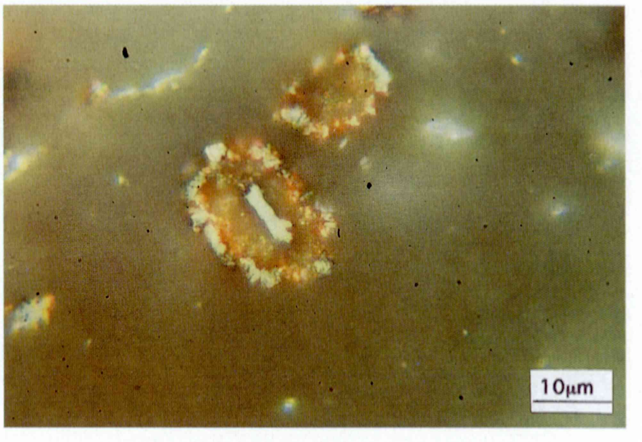

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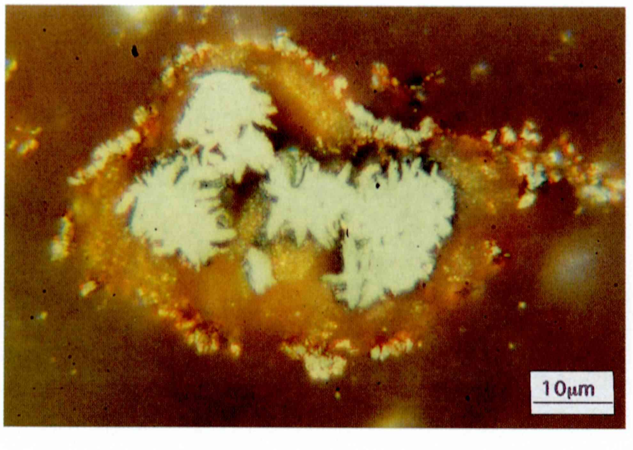

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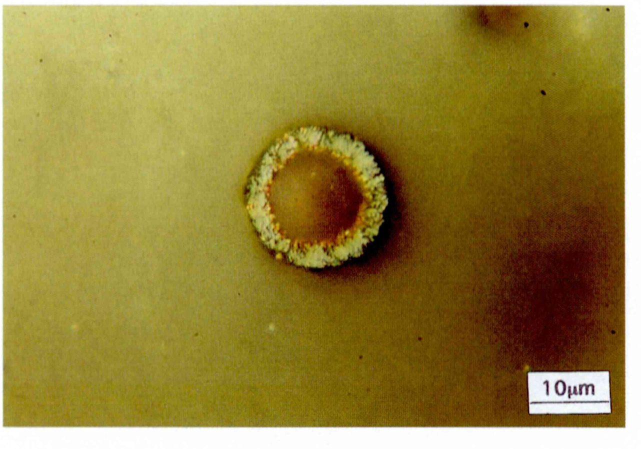

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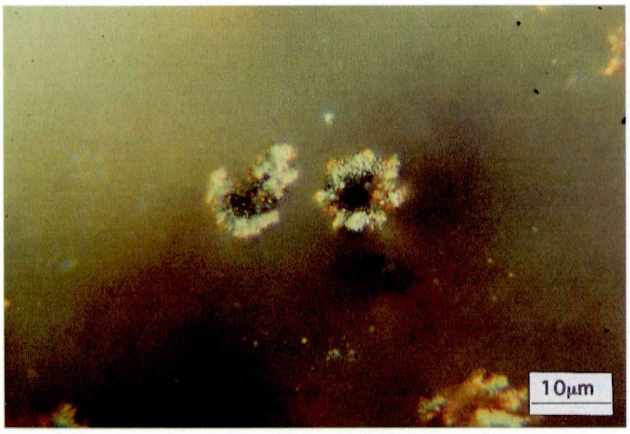

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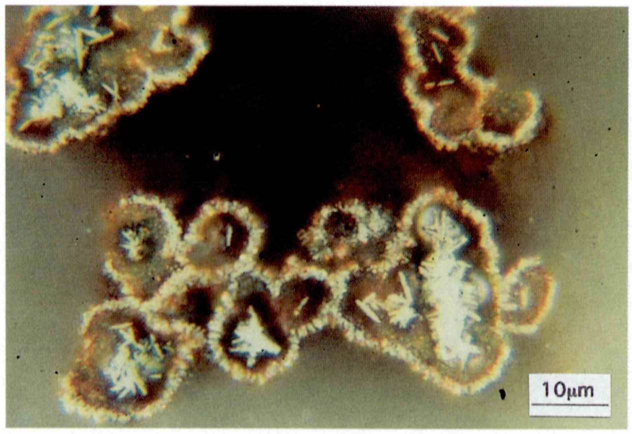

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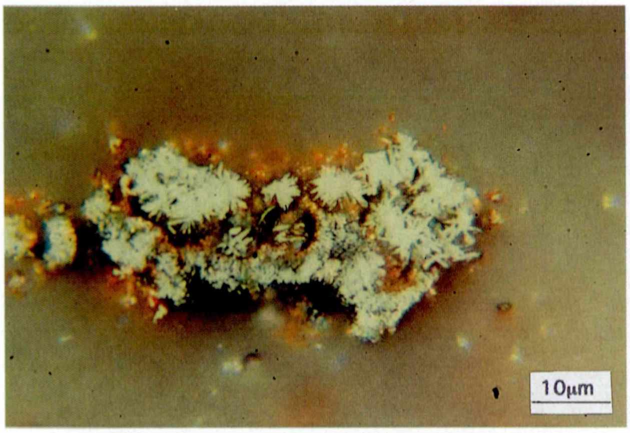

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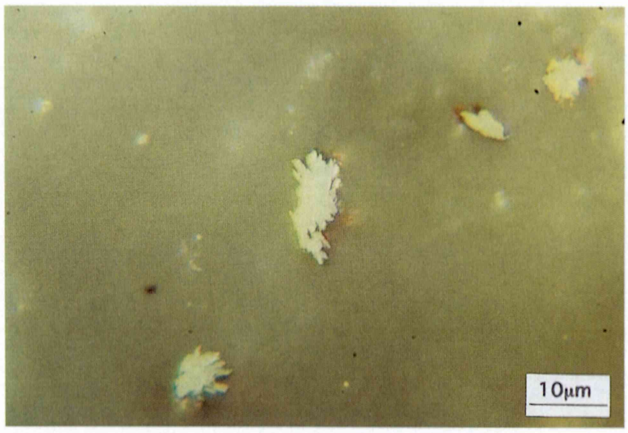

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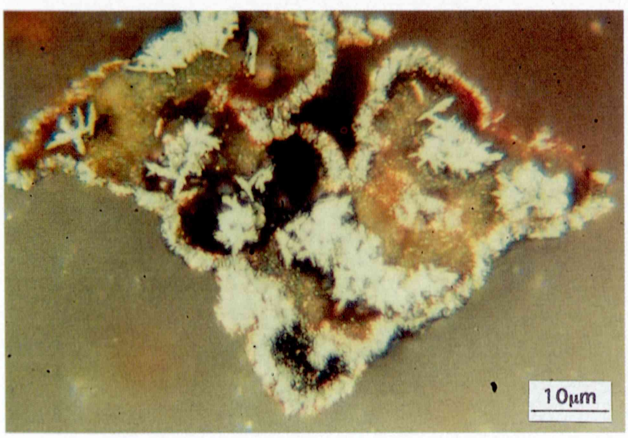

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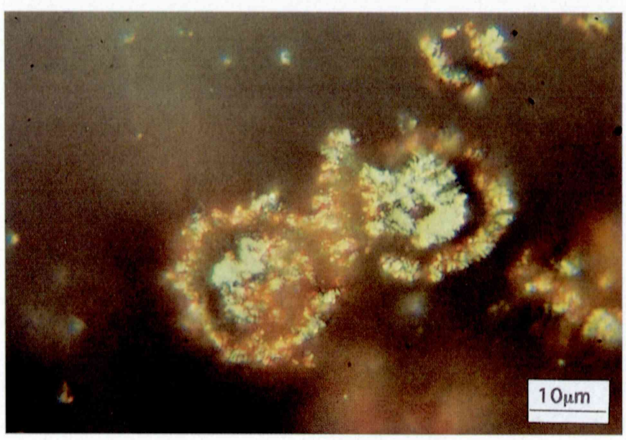

Fig. 12.