

NOTICES, ABSTRACTS AND REVIEWS

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THE CHROMIUM-BEARING MINERALS OF THE NORTH WEST FRONTIER PROVINCE

INTRODUCTION

During the past few years, many interesting minerals have been reported from the N.W.F.P. Of these, the chromium-bearing minerals — emerald, micas, spinel and tourmaline — merit special attention because of the economic and/or academic importance. Gem quality emerald from Swat and Mohmand Agency is sold at high price and has attracted a lot of people during the past few years. All of the chromium-bearing minerals are closely associated with ultramafic rocks from which chromium was derived by various mechanisms.

In this paper, the writer has tried to gather all the published data available on these occurrences, and has added some new informations.

Emerald.

Swat: Emerald occurs in carbonate-talc rock and in quartz veins near Mingora, Swat (Davies, 1962). The mineral, when enclosed in quartz, is invariably broken by latter fracturing and is of no commercial value; the better crystals are found in the soft carbonate-talc rock. According to Davies, the rock is largely composed of carbonate, quartz and talc, with minor proportion of chromium-mica (fuchsite and chlorite), ore, and (?) chromium-andradite. Jan (1968) has also reported clinzoisite in some of these rocks.

The emerald is very weak green pleochroic and has impurities of dark dusty material, some along the fractures, and may also contain vacuoles. It is uniaxial with refractive indices of 1.587 and 1.596 (both ± 0.003), and $\Delta = 0.009$. However, Davies (1962) has also reported some to be biaxial with a very small 2V. He writes, "these observations indicate that this beryl has a biaxial (orthorhombic) character, the pseudo-hexagonal form being due to twinning of orthorhombic units as in aragonite (Winchell, p. 464)".

Mohmand Agency: Emerald from Mohmand Agency was first reported by Waheduddin Ahmad (1966) near Nawe Dand. Recently, the mineral has also been found in Tora Tigga, Kuda Khel, Tsapari, and Dand Kandao (Prang Ghar) of the same Agency (Jan, 1968; Hayat, in press). It occurs in association with quartz veins in calcareous rock, quartz-mica schists, chlorite and talc-carbonate schists. Most

of the quartz veins run parallel to the foliation of the schists but some are accross to it, varying in thickness and length from a few inches to several feet. In Tsapari, epidote is associated with the emerald.

The emerald in these rocks is generally transparent, very weak pleochroic, devoid of fractures and contains only a few inclusions. The mineral is uniaxial negative which refractive indices of $\epsilon = 1.586$ and $\omega = 1.594$ (both ± 0.003), and $\Delta = 0.008$. In most cases, the grains show well-developed hexagonal prisms and basal pinacoids (Hayat, in press). The emerald ranges from a few mm to an inch in length and good crystals are sold at high price. Unfortunately, the local people have been using old technique of exploration which has resulted not only in spoiling the gems but also some deposits have been lost.

Chrome-Spinel.

Chrome-spinel of octahedral form, up to 2mm accross, is disseminated in a soft, fine-grained, dark-green amphibolite from Waziristan. The spinel is feebly magnetic and has a Cr_2O_3 content of 19% (Jan, in press). Beside the larger octahedra, the rock also contains minor quantities of anhedral spinel and traces of an unidentified white birefringent mineral. The amphibole in thin section is colourless to green pleochroic with low birefringence, nearly straight extinction, and has a few dusty inclusions. The rock is probably a metamorphosed peridotite in which spinel has survived metamorphism, or possibly been recrystallised in larger euhedral crystals. A similar sample, with larger crystals, has been reported from Shah Dheri area in Swat by Jan (in press).

Chrome-Tourmaline.

Chrome-tourmaline, in calcareous rocks, has been reported from Alpurgi, Swat (Long. $72^\circ 35' \text{ E}$; Lat. $35^\circ 54' \text{ N}$) by Jan, Kempe and Symes (in preparation). The rocks are composed of calcite and quartz with minor quantities of fuchsite, biotite, chlorite and ore. They are intruded by a lenticular serpentinite body (over 8 miles long) and quartz veins. Tourmaline occurs in traces near the former.

The mineral in thin section is in distinct grains but some is present between calcite, or around it in the form of girdles of minute granules adjacent to each other. It is not completely surrounded by quartz anywhere and is either contained in calcite or between calcite and quartz.

The mineral is in anhedral to subhedral grains some of which reach 2mm in length. It is free of impurities and has a few fractures. Its refractive indices ($\epsilon = 1.627$, green yellow; $\omega = 1.660$, deep green; both ± 0.003) are the same as those of a chrome-tourmaline (dravite) given in Deer *et al.*, (1962). The latter has a chrome content of 10.86%. Electron microprobe analysis of the mineral (Jan, Kempe and

Symes) shows a Cr_2O_3 content of 7.3% and $\text{V}_2\text{O}_5=0.2\%$. The mineral content is thought to have been introduced by silica-rich hydrothermal solutions which passed through or close to the ultramafics, and crystallised along with quartz in thin veins in calcareous rocks. A similar process may have produced emerald in Swat and Mohmand Agency. Jan *et al.*, citing the occurrence of the chrome-tourmalines reported by various people, think that the most common associations for chrome-tourmaline include serpentinites (and other ultrabasic rocks) and carbonates (including dolomites). Also, that they often contain vanadium and occur in association with fuchsite.

Fuchsite.

Fuchsite is locally present in calcareous and other rocks occurring close to the ultramafics in Swat, Dargai, and various parts of Mohmand Agency. The fuchsite-bearing rocks are greenish in most cases except at Mohmand Agency where they are brown with a touch of green, sometimes in layers. They contain siderite and/or calcite, fuchsite, quartz, and minor quantities of phlogopite. Some of the rocks also contain talc, chlorite and clinozoisite. The carbonate minerals are present in large euhedral to subhedral grains which, due to alteration, are brown in parts on edges and along cleavages in most cases. Most of these rocks in Mohmand Agency, apparently, have a high proportion of siderite with brownish-red colour.

Fuchsite is present in large, subhedral, tabular grains. It is pale green, pleochroic and has a high second order birefringence due, probably, to chromium content. The proportion of fuchsite varies from a few per cent to as much as 40%.

In the Dargai ultramafic complex near Harichand occurs a pinkish mineral along fractures in the ultramafic rocks. The mineral has not been investigated by the present writer, however, Dr. Bilgrami (personal communication) thinks it to be a chrome-chlorite (kammererite). It appears that the mineral is produced along fractures by alteration. Similar pinkish, fibrous mineral is also seen in a rock composed of talc, carbonate, quartz and spotty, green (?) nickel compound near Babo village, about 6 miles northeast of Shabqadar in Mohmand Agency. The rock occurs in patches and is closely associated with ultramafics.

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CHROMITE OCCURRENCES IN UTMANKHEL AREA OF MOHMAND AGENCY, N.W.F.P.

The Utmankhel area lies adjacent to Charsadda Tehsil of Peshawar district and its boundary starts about seven miles north of Tangi. A few samples of chromite were sent to the Department of Geology, by the locals, for identification in the fall of 1969. Later on, on the request of the tribal maliks, the author had a chance to conduct a reconnaissance survey to assess the potential of the mineralized area.

In the area under investigation the Peshawar plain skirts the hills where the elevation culminates from 1550 to 5520 feet. The ultramafic outcrops form a linear belt from two to five miles wide and extend for over 25 miles. The important localities in the Utmankhel area from where the chromite has been reported are in the vicinity of Babu, Bucha, Prangghar, Daghai and Balola villages.

During this survey, the author investigated only two localities close to Bucha and Babu. In Bucha area the country rocks consist of slate, phyllite, various types of schist and quartzite, intruded by the ultramafic rocks. There are seven pits, located about one and a half mile to the southwest of Bucha, from where chromite has been mined by the locals. The dimensions of the smallest and the largest pits were about 4 × 1 × 2 and 12 × 5 × 2 feet respectively.

