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Exotic Mineralogy of Newania Rauhaugite, India

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ABSTRACT

Newania rauhaugite shows the presence of at least 19 minerals. Apatite, magnetite, amphibole, pyroxene, phlogopite, pyrochlore, columbite, Nb-silicate, monazite, rutile, ilmenite, pyrite, bismite (Bi_2O_3), molybdenite, barite, galena and graphite occur as either embedded in dolomite or associated with it. In addition, hydrothermal fluids in form of veins riddling rauhaugite at several along the length of the outcrop, show presence of malachite, chalcopyrite and gold. In some veins even arsenic is also detected. In this short note, BSE images and compositions of some of these exotic minerals are presented.

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1. Characteristics of the minerals

1.1. Carbonates

The major masses of Newania carbonatite is rauhaugite (dolomitic) along with Fe-magnesite (Fig. 1) and later differentiate ankeritic melt. Dolomite, in some places, has high Fe content and thus can be called as ferron dolomite with up to 12.08% FeO. Dolomite also contains MnO from 0.82% to 1.05% and SrO 1.32%. Magnesite forms idiomorphic grains (Fig. 1), amount of Mg and Fe show significant variation (Mg from 12.44 to 23.65 wt.%, and Fe – from 44.24 to 50.34 wt.%). Sometimes magnesite associates with rutile and ilmenite. Presence of Fe-magnesite is significant feature of these rocks, because magnesite is rare mineral for carbonatites.

1.2. Apatite

Apatite (Fig. 1, 2) is abundant in the Newania rauhaugite and forms bands or lenses within dolomitic carbonatite and multiple of bands are observed all along the length of dolomitic carbonatite exposure. It also occurs as disseminated grains in both dolomitic and ankeritic carbonatites. Invariably it is fluorapatite with F content is as high as 5%. SrO content is also significantly high up to 2.9 wt.%. Often the mineral contains solid inclusions of monazite, columbite, and bismite (Fig. 3a). As observed, in Fig. 3b monazite also forms thin rim around apatite grains. Apatite also contains solid inclusions of columbite and graphite.

1.3. Ilmenite

Ilmenite occurs as tiny grains (Fig. 1, Fig. 4a, b) in association with magnesite and rutile and contains Nb up to 3.15 wt.%, Mn up to 1.41 wt.%, MgO up to 1.00 wt%, V up to 0.79 wt%.

1.4. Magnetite

Magnetite (Fig. 5) has higher amount of chromium (up to 0.75 wt.%) and TiO_2 (up to 1.26 wt.%). Amount of chromium in magnetite from carbonatites is usually below detection limit, higher chromium is a common feature of magnetite from mantle xenoliths and kimberlites. Sometimes the magnetite is oxidized to hematite. It is often surrounded by thin layer of graphite (Fig. 5).

1.5. Columbite

It occurs both as tiny independent grains and also as inclusions in apatite. It can be classed as Fe-

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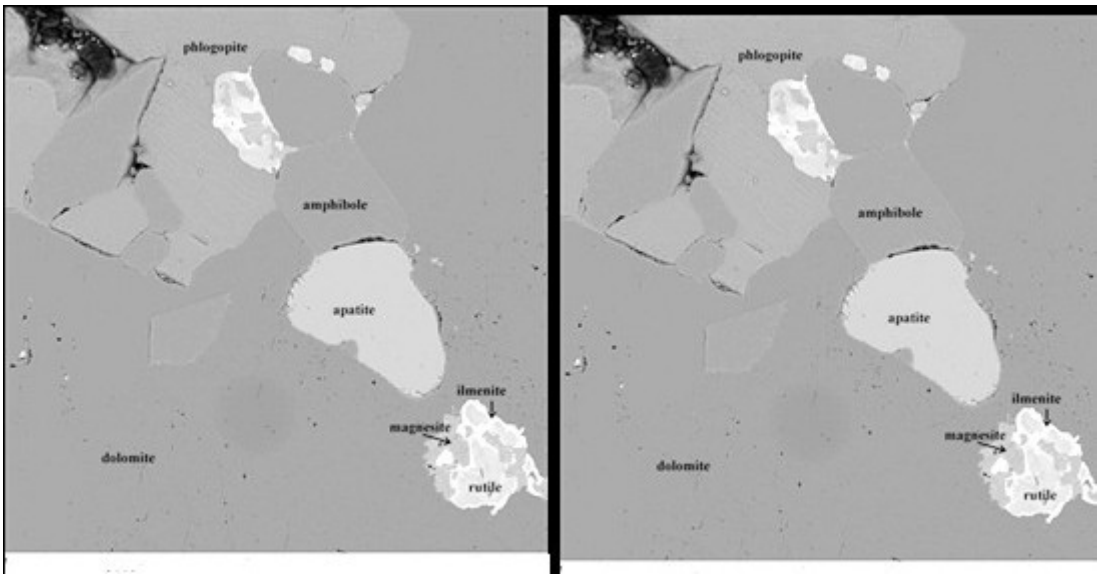

Fig. 1, 2. Apatite.

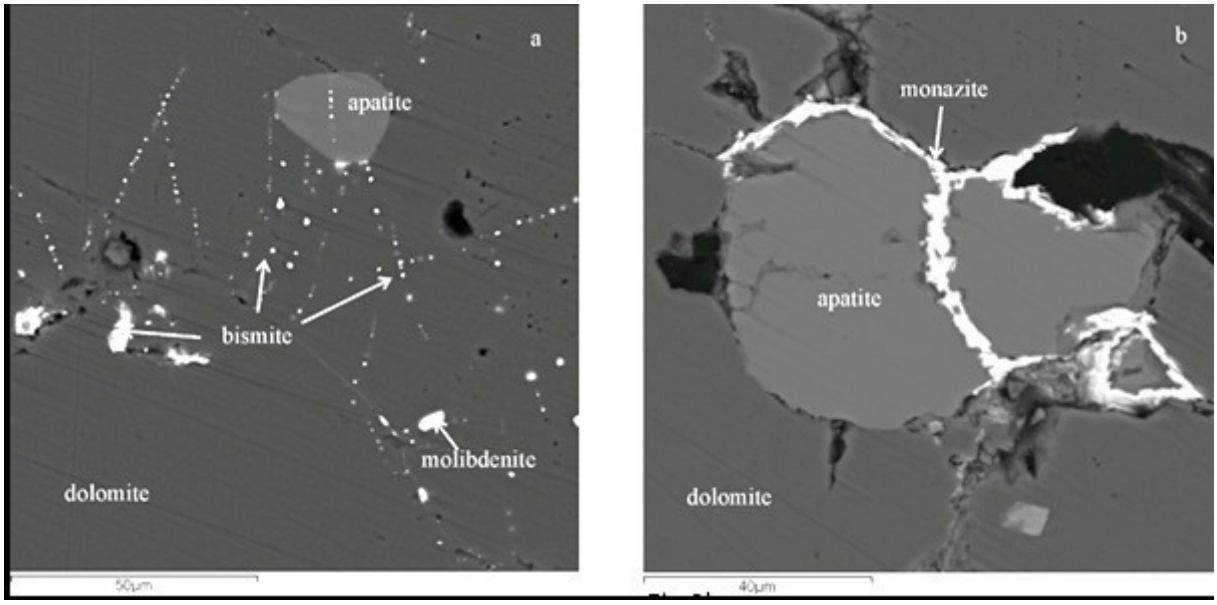

Fig. 3. a. Solid inclusions of monazite, columbite, and bismite in apatite. b. monazite also forms thin rim around apatite, which also contains solid inclusions of columbite and graphite.

columbite and contains Sc (up to 1.06 wt.%), MgO (up to 1.36 wt.%), TiO_2 (up to 2.61 wt.%), MnO (up to 1.16 wt.%), Ta (up to 7.81 wt.%).

1.6. Rutile

Rutile occurs as tiny primary mineral in rauhaugite in association with ilmenite (Fig. 2). It contains Nb (up to 5.73 wt.%), Fe (up to 2.84 wt.%), and V (up to 1.18 wt.%). In Fig. 2 it is seen to be associated with magnesite. It occurs in association with magnetite (Fig. 2). Nb bearing rutile is not uncommon and up to 9% Nb is found in rutile.

1.7. Graphite

Graphite is not a commonly found in carbonatites, however, in Newania it occurs as flakes in many samples of rauhaugite. Besides the independent flakes it also occurs as solid inclusions in some apatite grains. In some sections of rauhaugite these mineral forms a rim around large magnetite crystals as in Fig. 5.

1.8. Molybdenite and Bismite

These two minerals rarely occur in carbonatites and that is why their mention is significant here. In

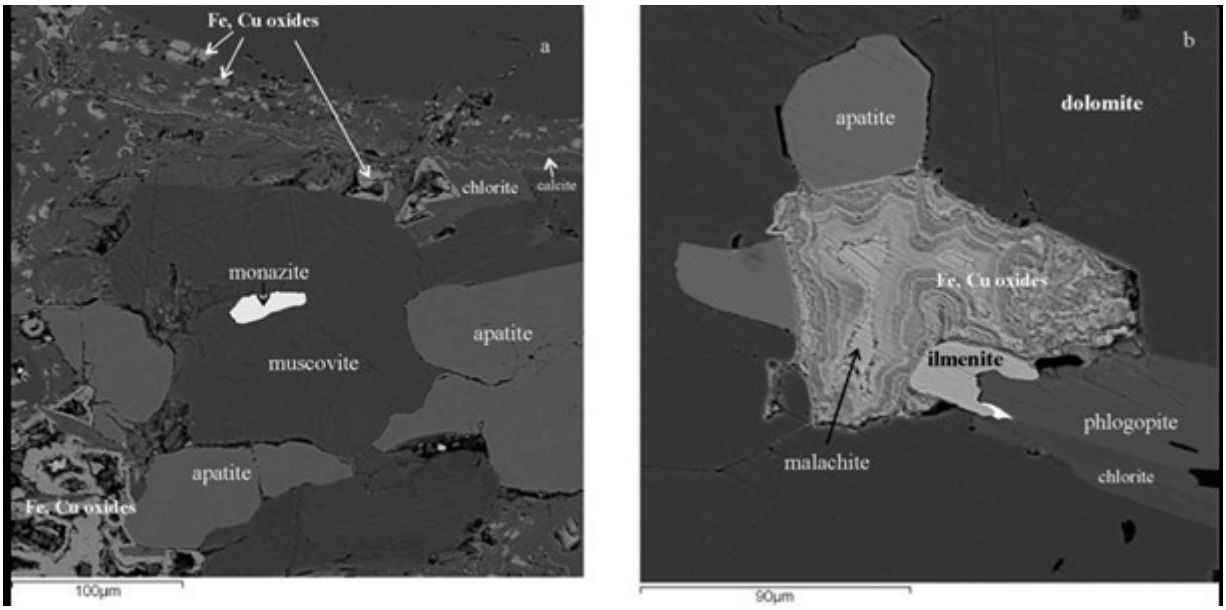

Fig. 4. a,b. Ilmenite occurs as tiny grains in association with magnesite and rutile.

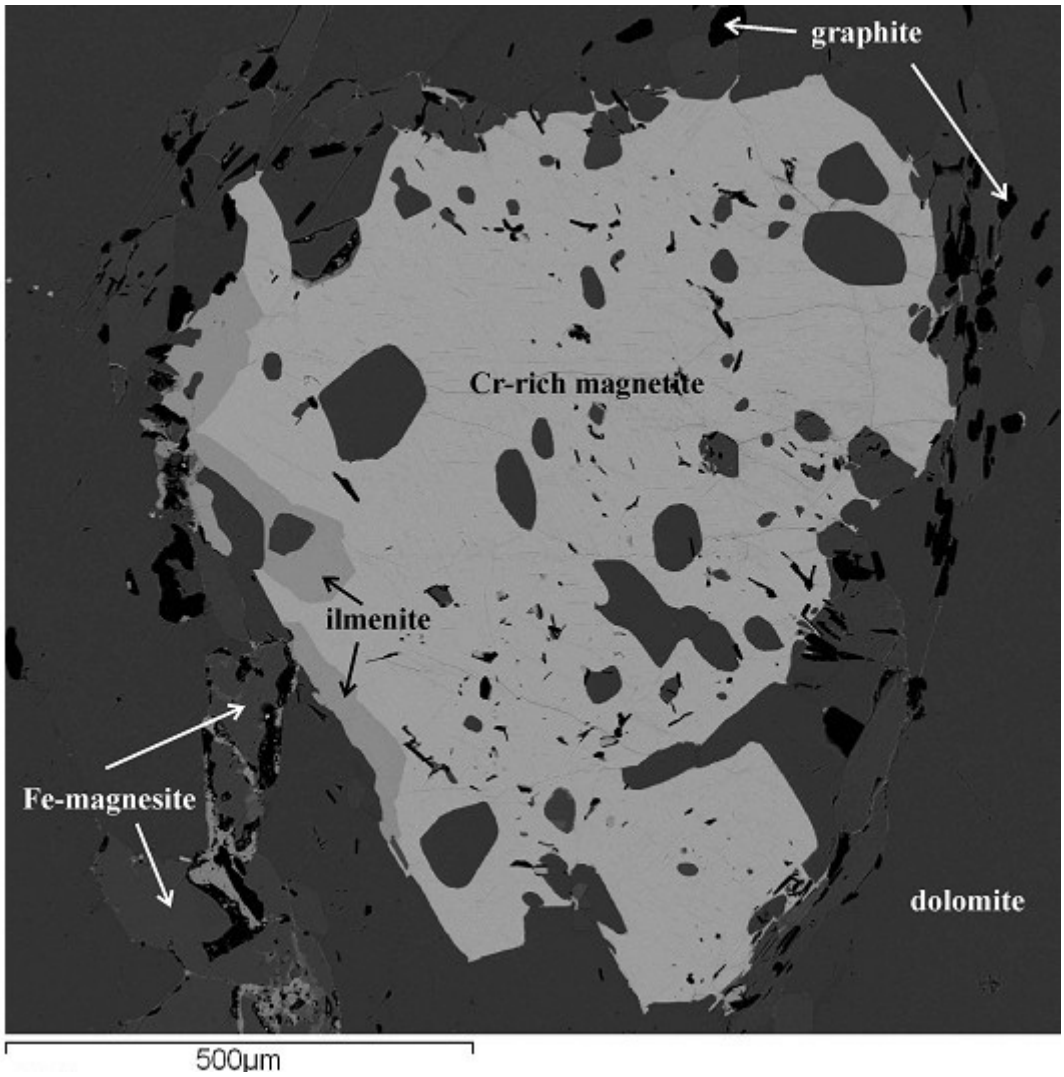

Fig. 5. Magnetite surrounded by graphite.

the present study they found to occur as primary minerals (Fig. 3a). Molybdenite is not uncommon carbonatites while bismite is rare. Molybdenite is reported to be an associated mineral in HREE-rich carbonatites e.g., in Qinling Mountains in China (Xu et al., 2010; Bai et al., 2019) and it occurs as independent grains in carbonatites as in the present case.

2. Hydrothermal veins

There is intense secondary hydrothermal mineralization. Fe and Cu oxides consist of veins, micro veins (malachite and chalcopyrite, Fig. 4a and b). Amounts of Fe and Cu in oxides are varying (Cu – from 1.66 to 8.29 wt.%, Fe – from 54.51 to 68.51 wt.%). Specks of gold and arsenic were detected in some veins along with malachite and chalcopyrite, arsenic amounts up to 1.93. Large number of pools of chalcopyrite and malachite mainly occur in ankeritic carbonatite which is a later fractionated phase of rauhaugite these were described earlier by Viladkar et al. (1993).

3. Discussion

The notable feature of the Newania carbonatite is the wide range of mineralogy that includes presence of uranopyrochlore, graphite and ferronmagnesite and is the best example of mantle derived Mg-rich carbonatite magma. In the successive generations of carbonatite, rauhaugite form the major mass occupying about 5 km long outcrop which is later intruded by ankeritic carbonatite. Earlier publications describe microprobe data on silicate minerals, apatite, magnetite, ilmenite etc in rauhaugite and ankerite (Viladkar and Wimmenauer, 1986), dolomite-magnesite-siderite series, graphite (Doroshkevich et al., 2010), and U-rich pyrochlore (Viladkar et al., 2017). The first brief description of this carbonatite was given by Phadke and Jhingran (1968) and subsequently by Deans and Powell (1968).

Magnesite is rare in carbonatites however; magnesite-siderite series has been described by Buckley and Woolley (1990) in some African carbonatites and by Doroshkevich et al. (2010), in Newania. Molybdenite, Bismite (Bi_2O_3) and arsenic are uncommon in carbonatites. Bismite, in carbonatite, can occur in oxidation zone. Or another possibility is original bismuth carbonate mineral has altered to form bismite. Arsenic could be from arsenic carbonate mineral or may be from associated Fe sulphides. REE in apatites of Newania are as high as 9900ppm, while REE in carbonatites are as high as 3800 ppm. Thus, Newania carbonatite is economically a very important complex. The carbonatite can be a major source of critical elements such as Nb and REE. However, no efforts have been made so far for exploiting these critical elements from this carbonatite.

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