Rare-earth arsenates and other rare-earth minerals from the Black Range Tin District, Sierra and Catron Counties, New Mexico*

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New or rare minerals, including rare-earth element (REE) arsenates, oxides, and vanadates, have been identified from lithophysal cavities and veins with associated tin mineralization in the Black Range tin district (BRTD). These minerals occur in sparse to minute amounts but are distinctive because of their color, habit, and mineral association. Details of the mineralogy of the BRTD are given in Foord et al., 1988, in which additional pertinent references are listed.

REE arsenates occur as three separate minerals having two different crystal structures. Chernovite-(Y) is the high-temperature form of $YAsO_4$ and has the tetragonal xenotime (YPO_4) structure, as well as being isostructural with zircon ($ZrSiO_4$) and thorite ($ThSiO_4$). Gasparite-(Ce), $CeAsO_4$, has the monoclinic monazite ($CePO_4$) structure, and was first described from the Italian Alps (Graeser and Schwander, 1987). Both of these minerals have been found at Squaw Creek and Paramount Canyon. The Ce-dominant analogue of chernovite has been found only at Paramount Canyon and is the third new species to be described from the BRTD, the first two being squawcreekite and maxwellite (Foord et al., in press).

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Solid solution exists between chernovite (As) and xenotime (P) (Graeser et al., 1973). Our studies indicate that solid solution, approaching 50 mol. % substitution of P for As, also exists between gasparite (As) and monazite (P). Coupled Th-Ca substitution for REE also is present, and as much as 5 wt. % ThO_2 and 1.5 wt. % CaO have been detected. Si substitution for P is almost nil. Chernovite-(Y) from Squaw Creek contains as much as 5 wt. % P_2O_5, 3.5 wt. % ThO_2 and 0.4 wt. % SiO_2. Small amounts of S substitute for As and P in both minerals.

The fourth possible permutation of the REE-As matrix, monoclinic $YAsO_4$, has not been found but should occur in nature. The high-temperature form of $REEAsO_4$ is tetragonal and the low-temperature form is monoclinic. Geologic, textural, and mineralogical evidence indicates that the depositional temperatures in the BRTD were high (300-800°C), with those at Paramount Canyon (tetragonal $YAsO_4$ and $CeAsO_4$) being higher than those at Squaw Creek (tetragonal $YAsO_4$ and monoclinic $CeAsO_4$).

Associated with the REE arsenates at Paramount Canyon are species that probably are cerianite, CeO_2, and wakefieldite-(Y), YVO_4. The cerianite occurs as inclusions and segregations within the chernovite and gasparite, and the wakefieldite occurs as rims on grains of chernovite-(Y). Identification of these two species is based solely on microprobe data because the small grain size (less than several microns) precludes X-ray diffraction studies.

Other REE-bearing minerals from the BRTD include chevkinite (or perrierite), and titanite, both from Willow Spring Draw. Details on both of these minerals are given in Foord et al. (1988). The titanite is unusual because of its high content (approximately 15 wt. %) of incompatible and rare elements.

The unusual combination of rare elements (e.g. Sb, Sn, As) and the absence or rarity of some more common ones (e.g. P) in the host rhyolites and later hydrothermal fluids, combined with appropriate P-T conditions, resulted in the formation of several new or rare mineral species. It is likely that more such minerals are present in the area, waiting for the diligent to discover them.

Reference:

Foord, E.E., Maxwell, C.H., and Hlava, P.F., 1988, Mineralogy of the Black Range Tin District, Sierra and Catron Counties, New Mexico. 9th Annual New Mexico Mineral Symposium, Socorro, NM. P. 23-27.

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