Igor V. Pekov, Inna S. Lykova

Rubtsovskoe Deposit
(North-West Altai, Russia): Mineralogy of the Oxidation Zone

Famous Mineral Localities

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FAMOUS MINERAL LOCALITIES **SERIES**

Igor V. Pekov, Inna S. Lykova (Lomonosov Moscow State University, Faculty of Geology)
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There are 96 pages, with 167 illustrations including 153 mineral photos and 44 chemical analyses of 17 minerals.

This issue of the *Mineralogical Almanac* is devoted to the mineralogy of the oxidation zone of the Rubtsovskoe base-metal deposit located in the north-west part of Rudnyi Altai (Altai Krai, Russia). This deposit, that has been operated as the Rubtsovsky mine of *Siberia-Polymetals* OJSC since 2005, became famous due to remarkable finds of supergene minerals. Uniquely rich iodide mineralization was discovered here. Rubtsovskoe is also a source of top-level specimens of native copper, cuprite, marshite, miersite, and iodargyrite. The issue contains the results of original mineralogical studies of the oxidation zone of the Rubtsovskoe deposit; 40 supergene minerals are described.

Front Cover photo Complicated auto-epitactic cluster of **cuprite**, 7 cm.
Specimen: *Russian Minerals* Company. Photo: Michael B. Leybov.

First Page Photo Native **silver** on **cuprite**, 2.5 cm. Private collection. Photo: Michael B. Leybov.

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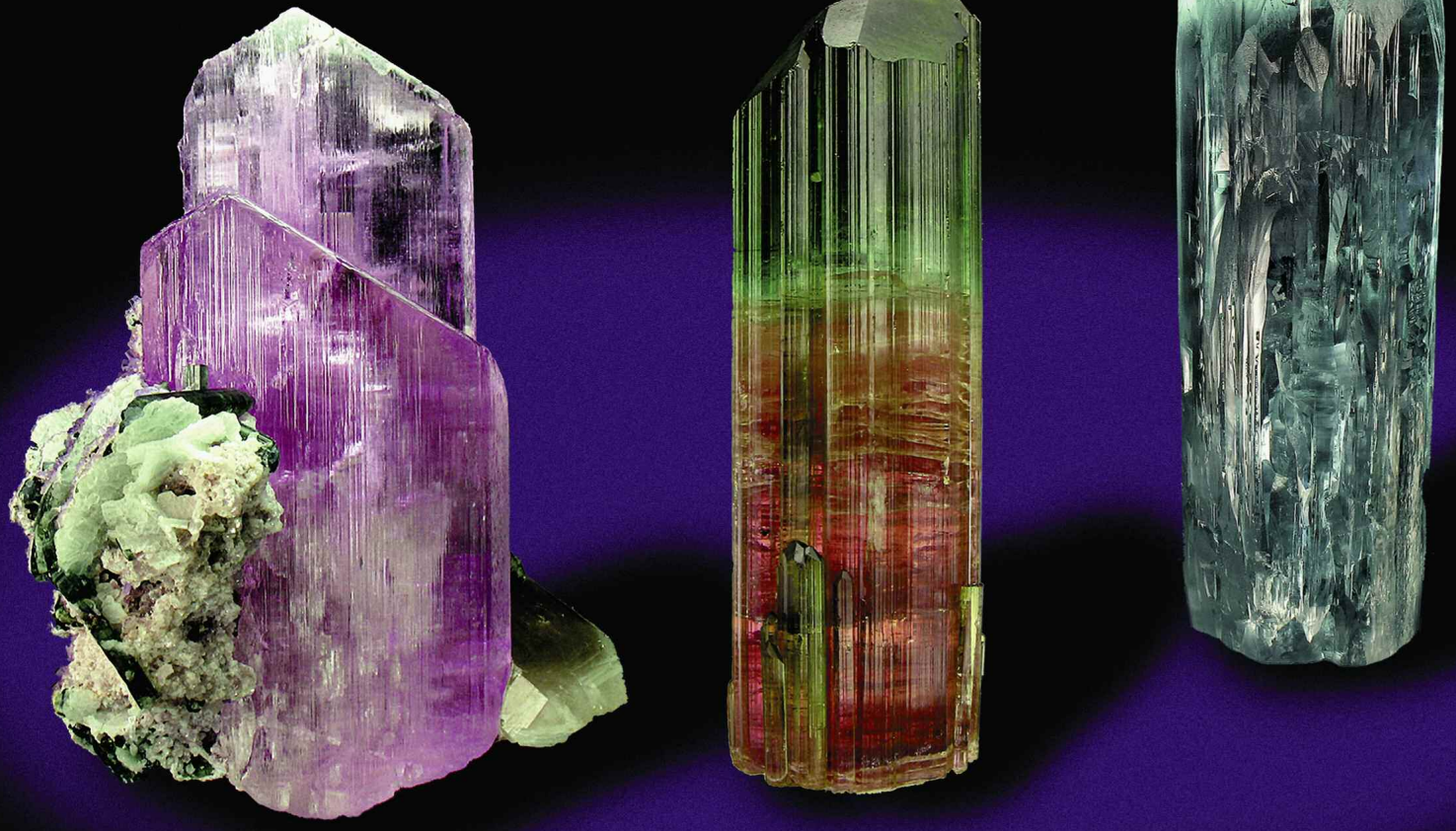

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Partial pseudomorph of native **copper** after octahedral crystal of **cuprite**, 6 cm. Collection: Anatoly V. Kasatkin. Photo: Michael B. Leybov.

INTRODUCTION

Despite its great size and varied ore deposits, Russia cannot boast many deposits with mineralogically impressive oxidation zones in which numerous spectacular specimens of supergene minerals are found. We can, however, mention three historical deposits in the Central Urals, which provided mainly in the 18th–19th centuries the magnificent specimens that adorn mineralogical museums worldwide: Berezovskoe with its rich chromate mineralization and Gumeshevskoe and Mednorudyanskoe, two major sources of famous Russian malachite. The other Russian deposits are much more modest, but some of them provided spectacular specimens from oxidation zones: Tur'inskie and Blagodatanye Mines, Central Urals; Taininsky, Trekhsvyatitel'sky, and Zerentuevsky Mines, Eastern Transbaikal Region; Zolotushinsky and Zmeinogorsky Mines, Rudnyi Altai; and Verkhny Mine in the Dalnegorsk ore field, Primorsky Krai. All of these deposits except Berezovskoe and Dal'negorsk were abandoned many years ago and became a part of history.

Fig. 1. Dendrite of native **copper** crowned by well-shaped, elongated twin on (111), 6 cm. Specimen: *Russian Minerals* Company. Photo: Michael B. Leybov.

Some other Russian mines, where poor developed oxidation zones are characterized by interesting mineralogy (for example, Blyava in the South Urals with varied sulfates and Khovu-Aksy in Tuva with numerous arsenates), were abandoned recently. Against this background, a discovery of rich original and extremely spectacular mineralization in the oxidation zone of the Rubtsovskoe base metal deposit at Rudnyi Altai is a great event.

The Rubtsovskoe deposit, unfamiliar as a mineralogical locality before 2008, became famous after the discovery of beautiful dendrites of native copper, including those powdered with native silver and well-described splendid cuprite provided its global fame.

The rich anomalous iodide mineralization found shortly after these findings was unexpected; previously, only insignificant iodides as micro-segregations were indentified at Russian deposits, including those at Rudnyi Altai. The most significant finding in our country was described from the supergene zone at the Gaiskoe massive sulfide deposit, South Urals, where Chitaeva *et al.* (1971) reported miersite AgI, with variable Cu content, in clusters of crystals up to 0.1 mm in size.

The scale of iodide mineralization at the Rubtsovskoe deposit is comparable only with that at the famous Broken Hill ore field in Australia, where rich pods of iodide minerals were found at late 19th century. Iodargyrite AgI was an important constituent of rich silver ores produced in the Proprietary and ABH Consols Mines from 1888 to 1893 (Smith, 1896; W.D. Birch, pers. comm.). The second occurrence is Rubtsovskoe, where rich silver ore with iodargyrite as the major economic mineral was produced at the upper levels in 2009.

Fig. 2. Geographical location of the Rubtsovskoe deposit.

There are few instances of rich iodide mineralization at Broken Hill; at the same time, at Rubtsovskoe we were permitted to do a regular investigation in an operating mine owing to the friendly treatment by the administration and geologists of *Siberia-Polymetals* OJSC. During 2009, when the blocks of the oxidized ores enriched in iodides were mined, we systematically studied fresh underground openings; and the most interesting occurrences were documented and sampled in detail for laboratory study. Rich iodide mineralization has never been studied in detail *in situ* before. Our investigation allowed not only the comprehensive characterization of the iodides from Rubtsovskoe, but also the determination of some common features of the formation of these minerals in nature (Pekov *et al.*, 2010).

Iodide mineralization is the major scientific pearl of Rubtsovskoe. However, we have also studied other mineralogical and geochemical aspects of the oxidation zone of this deposit. It was found that sulfates of the alunite-jarosite supergroup and smectites have unusual chemical compositions; ore-forming beaverite was found; and intriguing morphological features were identified for some minerals.

Marshite, clinoatacamite, schulenbergite, redgillite, and natural but not technogene connellite were found in the supergene zone of Rubtsovskoe for the first time in Russia. The best specimens of cuprite, native copper, marshite, miersite, and iodargyrite from Rubtsovskoe are highly competitive with those from classic foreign localities. Azurite from Rubtsovskoe warrants mentioning and the intergrowths of large perfect crystals of cuprite combined with native silver or miersite are unique worldwide.

⇩ *Fig. 3.* Distorted octahedral crystal of **cuprite**, 6 cm. Private collection. Photo: Michael B. Leybov.

⇘ *Fig. 4.* Cluster of **cuprite** crystals formed by faces {111} and {100}, 3 cm. Specimen: *Russian Minerals* Company. Photo: Michael B. Leybov.

⇧ *Fig. 5*. Group of octahedral crystals of **cuprite**, 5.5 cm. Specimen: *Russian Minerals* Company. Photo: Michael B. Leybov.

⇗ *Fig. 6*. Concretion of **azurite**, 2 cm. Private collection. Photo: Stanislav I. Pekov.

Fig. 7. Dendrite of native **copper** coated by cuprite film, 6 cm. Specimen: *Russian Minerals* Company. Photo: Stanislav I. Pekov.