

# Molybdenum Mineralization in the Ores of the Tigriny Tin Deposit (Primorye, Russia)

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**Abstract**—The molybdenum mineralization at the Tigriny tin deposit is considered for the first time in the light of possible recovery of Mo as a by-product of selective mining. It is established that Mo has a positive correlation with Bi and does not show a correlation with Sn, W, or Zn. The highest Mo grade ( $>0.1\%$ ) in the ore stockwork is related to hornfels near the exposed granite porphyry stock and decreases downward by an order of magnitude. At the level of adit 5, the most numerous quartz–molybdenite veinlets develop at a distance of 50–100 m from the granite porphyry stock. The molybdenite–quartz, pegmatoid, and autogreisen generations of molybdenum mineralization are related to different substages of the first ore stage. All these generations predated crystallization of wolframite, cassiterite, and other ore minerals. The formation temperature for each molybdenite generation was determined by homogenization of fluid inclusions in quartz and decrepitation of samples characterizing each molybdenite-bearing assemblage. These data allowed us not only to estimate the crystallization temperature of each molybdenite generation but also to establish that the molybdenite crystallized from a pneumatolytic–hydrothermal melt–solution at the early stage of the deposit formation. The molybdenum mineralization is genetically related to the granite porphyry stock. The structure of the quartz–molybdenum stockwork was studied to determine the clusters of quartz–molybdenite veinlets and establish their orientation. Molybdenite 1 occurs in variably oriented veinlets that make up a stockwork around the apical portion of the porphyry stock. Disseminations and pockets of molybdenites 2 and 3 are hosted in pegmatoid rocks, greisen, and greisenized granite porphyry. The density of the Tigriny stockwork varies from 0 to 40–50 quartz–molybdenite veinlets per 5 m. Their orientation and spatial distribution were studied in quantitative terms. The most promising targets for selective mining of molybdenite from the Tigriny deposit are the framework of the Minor porphyry stock and the apical portion of the Main stock. The Tigriny deposit demonstrates a clear relationship between ore formation and granitic magmatism.

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## INTRODUCTION

In recent years, the world consumption of molybdenum has grown steadily with an average annual rate of 2–3%. For the last few years, the world demand for this metal has exceeded its supply. The highest demand for this metal comes from the countries of the Asia-Pacific region, Europe, and the United States. The annual demand for Mo is expected to either remain at the same level or even increase.

Molybdenum and copper–molybdenum porphyry deposits are the major economic types of Mo deposits; skarn and vein deposits are of subordinate importance. Molybdenum is also mined from deposits of other metals as a by-product, and the output of these deposits is quite comparable with that of the Mo deposits proper.

Seven of ten economic molybdenum deposits explored to date in Russia have been developed. Except one deposit in the North Caucasus, the explored deposits are situated in the Transbaikalian region. As follows from the broad extent of molybdenum mineralization in

the Russian Far East (Fig. 1), this territory, located adjacent to the countries of the Asia-Pacific region, has a high resource potential for discovery of economic molybdenum deposits. The Umal'ta molybdenum vein deposit was mined here during World War II (Pokalov, 1978). Tens of small molybdenum (copper–molybdenum), tungsten–molybdenum, tin–molybdenum, and gold–molybdenum deposits and occurrences are known from many ore districts.

To specify the position of areas enriched in Mo, we compiled a scheme of the extent of molybdenum mineralization based on the *Registration Map of Endogenic Mineral Resources on a Scale of 1 : 15000000* of Sukhov et al. (2000). Averaging with a  $1 \times 1$  cm sliding window was applied to the map of the study area to determine the extent of mineralization. Economic deposits were estimated at eight points, subeconomic deposits at four points, and ore occurrences at two points. The obtained quantitative indices varied from 1 to 50 points. A formalized scheme was constructed with contour lines at 5, 10, and 25 points (Fig. 1).

The real prerequisites exist for discovery of economic molybdenum and copper–molybdenum por-

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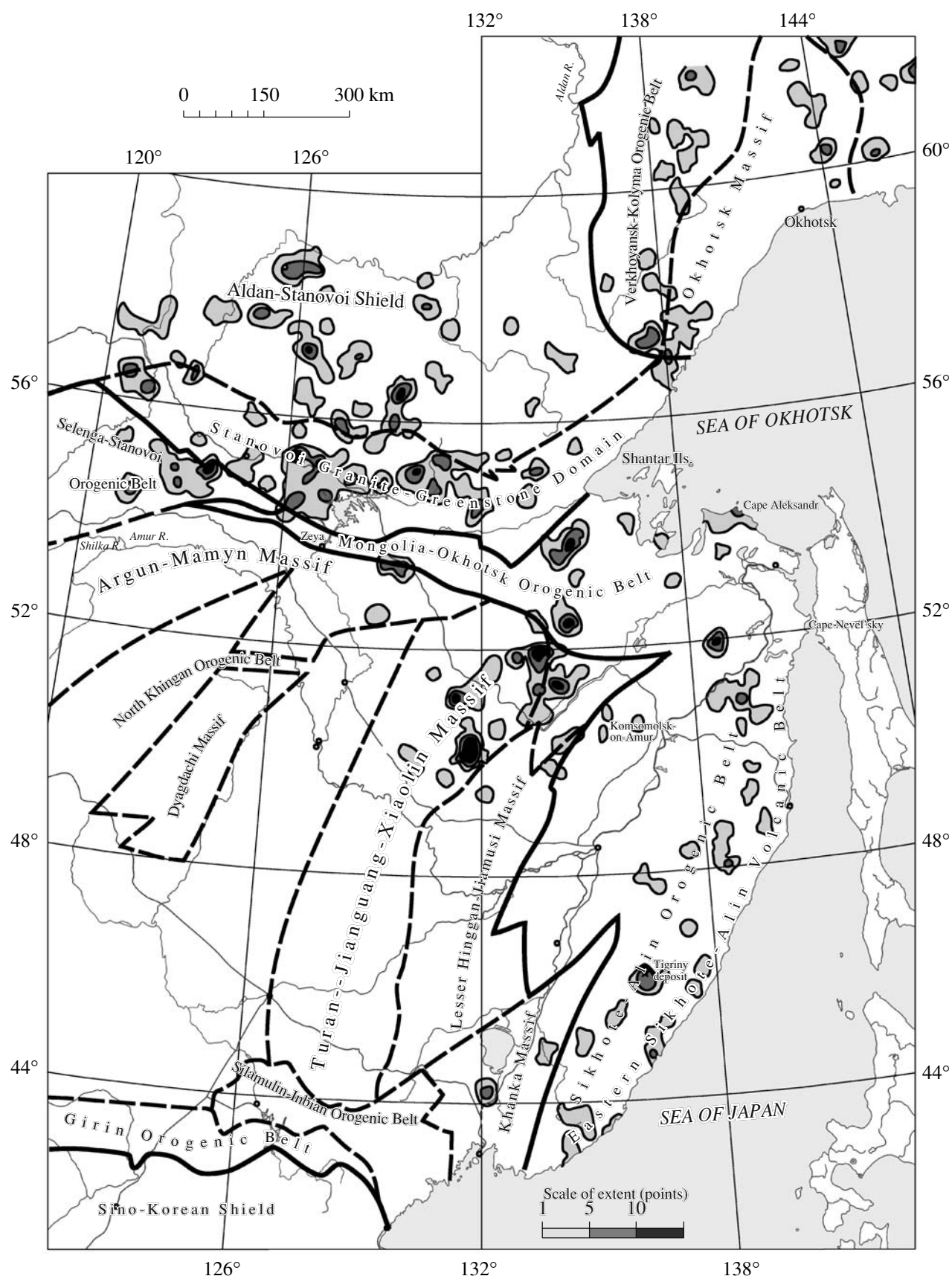


**Fig. 1.** Scheme of the extent of molybdenum mineralization in the southern Far East, compiled by N.P. Romanovsky and V.G. Gurovich.

phyry deposits (Sukhov and Rodionov, 1986; Ruchkin et al., 1988; Tomson et al., 1996). Furthermore, molybdenum is also contained in already mined deposits of other metals. While assessing the tin potential of the Tigriny and Taborny ore fields in 1986, A.A. Schnaider and M.S. Schnaider noted the molybdenum mineralization at the Tigriny tin–tungsten deposit (Ruchkin et al., 1986). Molybdenite was also revealed at deep levels of other tin deposits and prospects (Korostelev et al., 1998; Rodionov, 2005; Kopylov et al., 2004; Gonevchuk et al., 2006).

At some tin deposits, the molybdenum mineralization is only of mineralogical interest, while at other deposits molybdenum can be mined as a by-product, as is exemplified by the Tigriny deposit, one of the largest tin–tungsten greisen deposits with complex ores. This work is aimed at studying the geochemical features of molybdenum mineralization and its spatiotemporal distribution at the Tigriny deposit.

### GEOLOGICAL OVERVIEW OF THE TIGRINY DEPOSIT

The geology of the Tigriny tin–tungsten deposit was described in detail by Rodionov and Rodionova (1980), Rodionov et al. (1984b), Ruchkin et al. (1985, 1986, 1987, 1988, 1989), Korostelev et al. (1990), Rodionov (2005), Gonevchuk et al. (2006), Rub et al. (1991, 1998), Rub and Rub (2006), and Ruchkin et al. (1988).

The Tigriny deposit is situated in the western part of the Armu ore district of Primorye and localized in a small dome that complicates a large arch (Rodionov et al., 1984a, 1984b; Rodionov, 2005) in the zone affected by the NNW-trending Central and ENE-trending Tigrinka faults. The ore field is composed of a thick Lower Cretaceous sedimentary sequence (siltstones, mudstones, and sandstones with sporadic units of gravelstones and conglomerates) deformed in large NE-trending folds. Rhyolite and granite porphyries and greisenized leucogranite are the most abundant igneous rocks. Leucogranite occurs as a morphologically complex stocklike body and a dike suite; dikes of pre-granite ongorhyolite and porphyritic monzonitoid rocks are known from the marginal part of the ore field, and post-mineral dikes of olivine basalt, from its central portion (Gonevchuk et al., 2006).

The Tigriny deposit is spatially and genetically related to the Tigriny granitic stock (Fig. 2), with a series of cupolas and near-meridional and near-longitudinal offsets. The two largest cupolas are referred to by local geologists as the Main and Minor stocks. The stock as a whole is composed of leucogranite porphyry and porphyritic medium-grained protolithionite and protolithionite–zinnwaldite granite, described in detail by Korostelev et al. (1990), Rodionov and Rodionova (1980), Rodionov et al. (1984b), Rodionov (2005), Rub et al. (1986, 1991, 1998), Rub and Rub (2006), Gonevchuk et al. (1998, 2006), and Belyatsky et al. (1998).

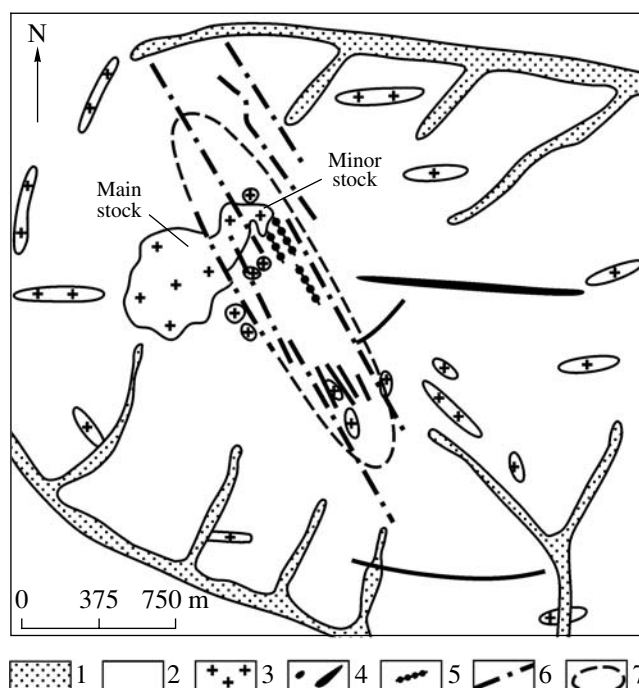


**Fig. 2.** Geological scheme of the Tigriny deposit (Rodionov et al., 1984b). (1) Alluvium, (2) terrigenous rock, (3) granite porphyry of the Tigriny stock, (4) intrusion of intermediate composition, (5) dikes of diverse composition, (6) fault, (7) contour of stockwork zone.

The southern contact zone comprises marginal pegmatites and stockscheiders. The strongly silicified granite that occurs at deep levels is interpreted by Ruchkin et al. (1986) as an immiscible silexite.

The available isotopic geochronological data (Gonevchuk et al., 1987, 2006; Gerasimov et al., 1990; Rub et al., 1986, 1991; Tomson et al., 1996; Belyatsky et al., 1998; Ishihara et al., 1997; Rodionov, 2005; Rub and Rub, 2006) indicate that the ore-magmatic system was formed 90–67 Ma ago. The subalkali olivine basalt of postmineral dikes is the youngest ( $27 \pm 3$  Ma) igneous rock in the ore field (Rub et al., 1986).

The ore zones comprise a blanketlike greisen body, linear stockworks and veins, and ore-bearing bodies of explosion breccia. These morphological types of ore mineralization were formed during three stages recognized in the evolution of the ore-magmatic system (Ruchkin et al., 1985, 1986, 1987, 1988, 1989; Rub and Rub, 2006). About 150 minerals have been identified in the ore. Cassiterite, wolframite, and sphalerite are the major minerals; stannite, arsenopyrite, chalcopryrite, and molybdenite are less abundant. Several ore assemblages are distinguished; the molybdenite–quartz assemblage, with bismuthinite, native bismuth, and bismuth and gold tellurides, was formed at the first stage.

## DISTRIBUTION OF MOLYBDENUM MINERALIZATION

The molybdenite–quartz assemblage occurs as a series of ENE-trending and gently dipping veinlets hosted in the granite porphyry of the Tigriny stock and country sedimentary rocks. The distribution of Mo in the Tigriny stockwork is shown in Fig. 3. Two tracts of elevated Mo contents ( $>0.001\%$ ) are traced at the ground surface, in the axial part of the stockwork zone and along its eastern (hanging) wall. The highest Mo contents ( $>0.1\%$ ) are detected in hornfels near the exposed apical portion of the Tigriny stock. At a depth, in the central part of the stockwork (the level of adit 5), the Mo grade is an order of magnitude lower than at the surface, varying from 0.0001 to 0.001%. Drilling in the middle part of the stockwork ore zone (exploration line 14) confirmed the decrease in Mo content with depth, whereas the number of molybdenite–quartz veins is seen to increase downward in the western and north-western parts of the stock.

The specific features of molybdenum mineralization in comparison with tin–tungsten and sulfide ores are expressed in the character of Mo correlation with other ore components. The sampling of the ground surface, the level of adit 5, and the boreholes penetrating the Tigriny stockwork has demonstrated that Mo shows a positive correlation with Bi and is not correlated with Sn, W, or Zn (Fig. 4).

## GENERATIONS OF MOLYBDENUM MINERALIZATION

Three molybdenite generations are recognized in the primary ore at the Tigriny deposit. An insignificant amount of wulfenite is noted in the oxidation zone. All generations of molybdenite predated the formation of wolframite, cassiterite, and other ore minerals. The geological relationships of molybdenite mineralization with igneous rocks and other mineral assemblages are shown in Fig. 5.

*Molybdenite 1* is related to the molybdenite–quartz substage and occurs in randomly oriented molybdenite–quartz veinlets that crosscut barren quartz veinlets and the chilled margin of the stock and are, in turn, crossed by bodies of pegmatoid granite, greisen, and greisenized granite porphyry, as well as subsequent near-parallel tin–tungsten veinlets and sulfide veins. Fine-grained quartz aggregates are densely impregnated with tiny (from 0.00n to 1–2 mm) flakes of molybdenite 1. Selvages enriched in molybdenite impart a zonal appearance to veinlets; molybdenite-rich bands are observed in the inner parts of veinlets as well. Molybdenite 1 is often intergrown with small bismuthinite grains. In addition to the aforementioned minerals, the molybdenite–quartz substage is characterized by small amounts of bismuth tellurides, native bismuth, native gold, arsenopyrite, and fluorite (Gonevchuk et al., 2006).

The quartz–molybdenite veinlets are similar to the barren quartz veinlets in morphology, thickness, extent, and spatial distribution within the Tigriny stockwork (Fig. 6). In the hornfels and in the contact zone, 10–15 veinlets per meter are observed. At the level of adit 5, the veinlets are grouped around the Minor stock. The orientations of the quartz–molybdenite veinlets are various—near-vertical to horizontal. Near the Main stock, veinlets oriented parallel to the stock contact and dipping toward the stock are predominant. It is suggested that these veinlets filled the fractures formed in the process of stock emplacement. Moving away from the stock, the veinlets become extended in the NW direction, i.e., acquire the predominant orientation of the fractures in the Tigriny stockwork.

Decrepitation of samples taken from the quartz–molybdenite veinlets and homogenization of fluid inclusions in quartz showed that the molybdenite–quartz veinlets were formed within the temperature interval 420–300°C. The high-temperature inclusions were homogenized into gas (type II), while the low-temperature inclusions were homogenized into liquid (type I). Thus, pneumatolytic–hydrothermal mineral-forming solutions existed at this stage (Ermakov, 1950).

*Molybdenite 2* was formed at the pegmatite substage and is hosted in discontinuous pegmatoid zones that are conformable to the low-angle contacts of the stock and localized between the outer chilled margin and the greisenized granite porphyry in the inner portion of the stock. The thickness of the pegmatoid zones varies from a few meters to 20–25 m. Thin pegmatite veins crosscut leucogranite of the contact zone and enter hornfels and, in turn, are crossed by veins of greisen and greisenized granite porphyry, as well as by mineralized veinlets of the second and third stages. Molybdenite 2 occurs as large (from 5 to 25–30 mm in size) flakes and pockets intervening between large feldspar and quartz crystals and is associated with bismuthinite, guanajuatite (selenobismuthite), muscovite, and sporadic zinnwaldite.

The homogenization temperature of fluid inclusions in quartz from pegmatoids varies from  $>650$  to 450°C. It is noteworthy that quartz contains both fluid and melt inclusions. The primary fluid inclusions are homogenized into gas (type II) at  $T = 590$  and 450°C. The coexistence of fluid inclusions that are homogenized into gas with melt inclusions indicates that these mineral aggregates crystallized from a volatile-rich magmatic melt. Marakushev et al. (1981) supposed that such a melt–solution begins to crystallize at a high temperature and completely solidifies at a fairly low temperature with a transition from a eutectic to a gel. The presence of Li (even in tenths of a percent) depresses the crystallization temperature of the given eutectic.

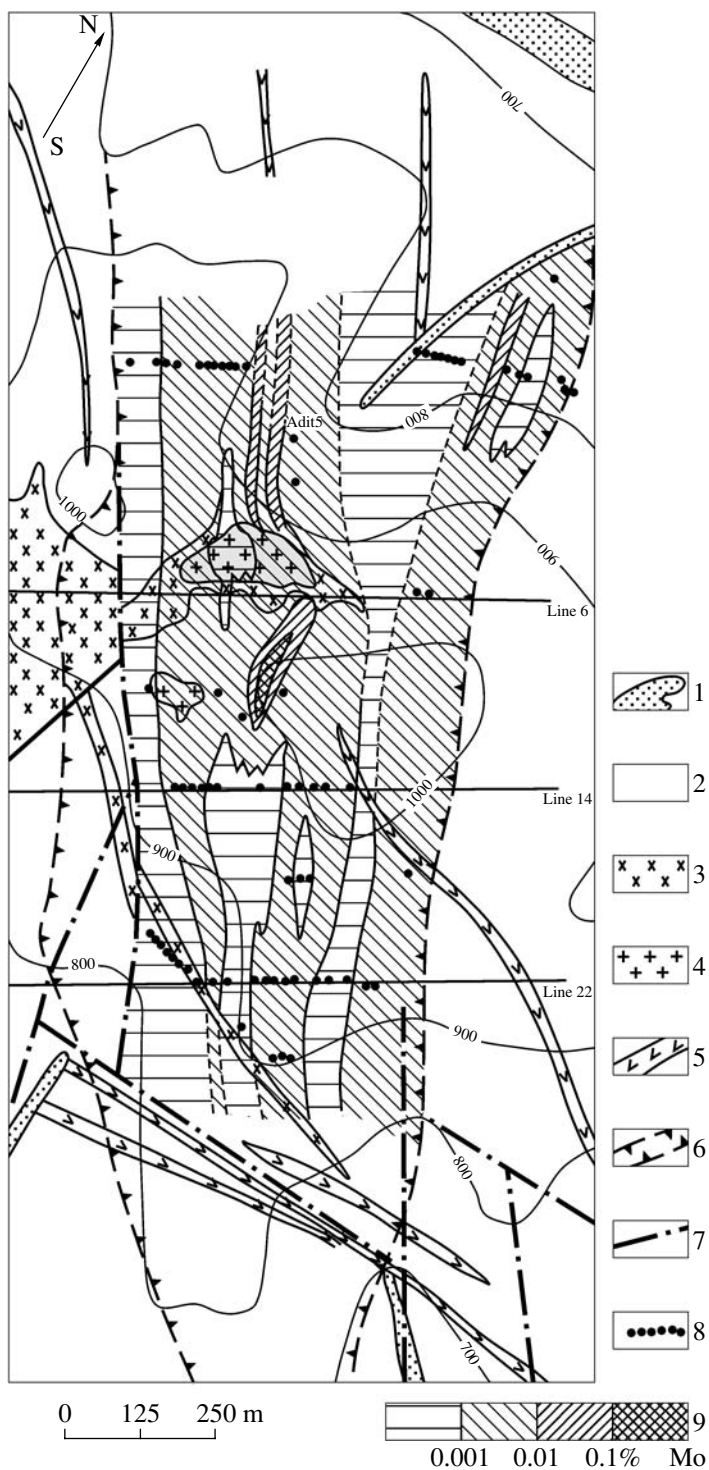


**Fig. 3.** Molybdenum halos of the Tigriny stockwork at the ground surface. Compiled by A.A. Schnaider using the data of the Tazhny GRE, PPGO Primorgeologiya. (1) Alluvial sediments, (2) hornfels, (3) fine-grained granite (dikes and contact chilled zone of the stock), (4) granite porphyry, (5) basaltic dikes, (6) contours of ore zones, (7) faults, (8) sample location, (9) Mo content in the ore zone.

*Molybdenite 3* is related to the greisen substage; products of this substage make up conformable greisen bodies in the apical parts of leucogranitic cupolas. This

stage of autometasomatic alteration of granite porphyry was characterized by albitization of potassium feldspar; bleaching of biotite; and replacement of phenocrysts

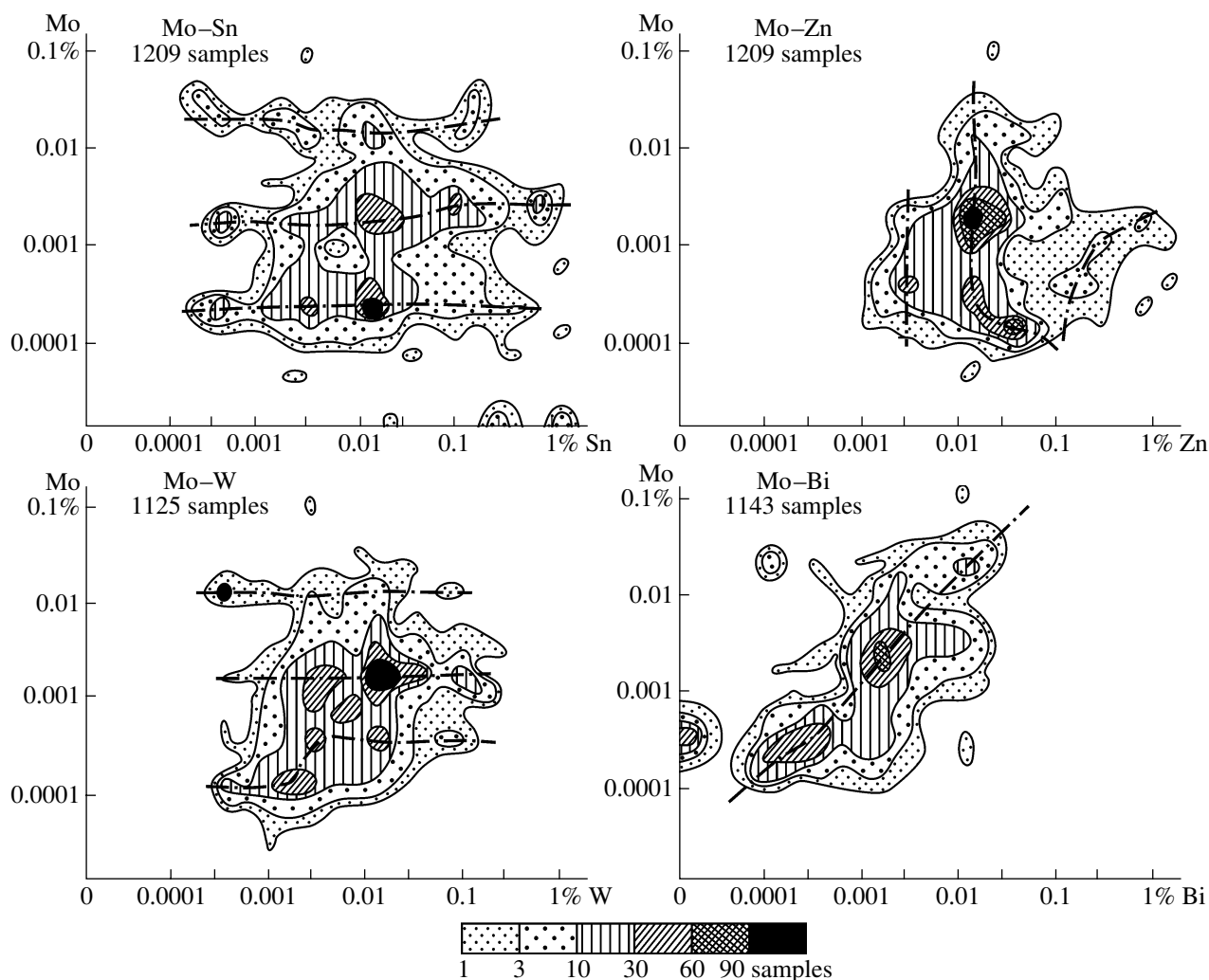


**Fig. 4.** Correlation of Mo with Sn, W, Zn, and Bi in the ore of the Tigriny stockwork. Compiled by A.A. Schnaider and M.S. Schnaider on the basis of sampling of trenches and cores of boreholes 5, 6, and 7 and analytical data of the Snezhnyy GRP, Tazhnyy GRE, PGO Primorgeologiya.

and groundmass by newly formed quartz, zinnwaldite, muscovite, topaz, cassiterite, wolframite, fluorite, bismuthinite, ilmenite, arsenopyrite, sphalerite, and stannite. Molybdenite 3 occurs as small (up to 3–5 mm) flakes in greisenized granite porphyry and in short and thin tortuous veinlets in the marginal parts of the greisen bodies together with quartz, feldspar, zinnwaldite, topaz, and other minerals (Fig. 5). Molybdenite 3 is one of the earliest ore minerals among those listed above.

The intensity of greisenization gradually increases toward the granite porphyry cupola. The content of ore components in greisen increases in the same direction; thereby, the textural pattern of ore changes from sparsely to densely impregnated mineralization, giving way further to small, medium, and large pockets containing up to 50–60% ore minerals. Greisen veins crosscut pegmatoid rocks and the contact zone of aplites, felsites, and quartz porphyry, often entering hornfels.

The fluid inclusions in quartz from greisen are homogenized at a temperature of  $>650$  to  $300^{\circ}\text{C}$ . Like pegmatoid rocks, quartz entrapped both fluid and melt inclusions; the latter contain cassiterite and wolframite. The fluid inclusions are homogenized into gas (type II) at  $T = 300^{\circ}\text{C}$ .

#### STRUCTURE OF QUARTZ–MOLYBDENITE STOCKWORK

Molybdenite 1 occurs in the variably oriented quartz–molybdenite veinlets that make up stockwork halos around granitic cupolas and in their contact zones (Figs. 6, 7); molybdenites 2 and 3 are present as pockets and disseminations in pegmatoid and greisen bodies and greisenized granite porphyry. All three molybdenite generations are contained in fragments of hydrothermal breccia emplaced at the third, final stage of the mineral formation. The stockwork molybdenite miner-

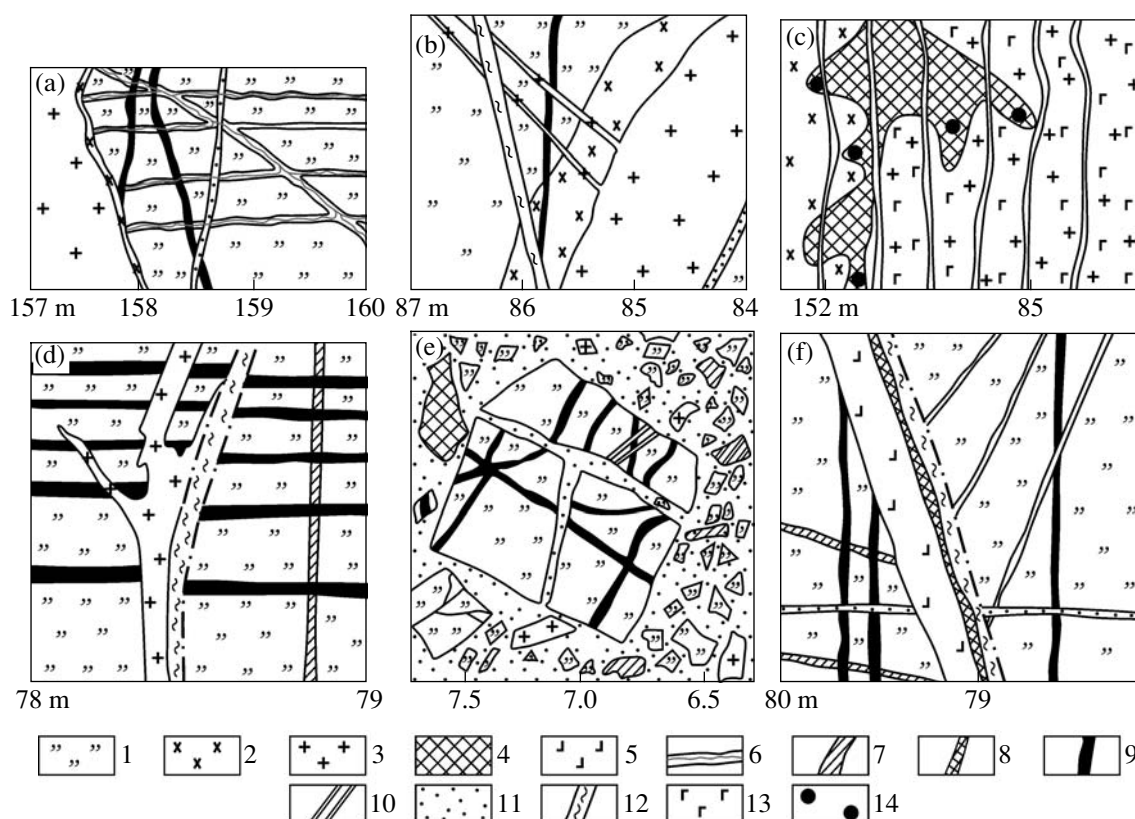


**Fig. 5.** Geological relationships of molybdenite mineralization at the Tigriny deposit. Sketches were made by A.A. Schneider in workings of adit 5 (level 850 m). (1) Hornfels; (2) fine-grained rocks of the contact chilled zone of the stock (quartz and quartz-feldspar porphyries, felsite, aplite, silexite); (3) granite porphyry; (4) pegmatoid rock; (5) olivine basalt; (6) veinlet of early banded quartz; (7) veinlet of early massive quartz; (8) thin kaolin zones; (9) quartz-molybdenite veinlet; (10) ore veinlet of the second stage; (11) mineral assemblages of the third type (veins, veinlets, breccia cement); (12) late fault zones; (13) greisenized rock; (14) pockets of molybdenite 2. (a) Quartz-molybdenite veinlets crosscut early veinlets of banded quartz and the contact chilled zone of the stock and, in turn, are cut by sulfide stringers of the third stage; drift 14, the southeastern wall. (b) A quartz-molybdenite veinlet crosscuts the contact chilled zone and is cut by greisenized granite porphyry and a postmineral fault; drift 22, the northwestern wall. (c) Pockets of molybdenite 2 in pegmatoid rock; drift 4, the northwestern wall. (d) A system of near-parallel low-angle quartz-molybdenite veins is crosscut by a granite porphyry dike with a fault along the contact; a veinlet of early massive quartz is seen; drift 6, the southwestern wall. (e) Hydrothermal breccia; a dismembered hornfels fragment is cut by quartz-molybdenite veinlets of the first stage, which, in turn, are cut by quartz-feldspar veinlets of the second stage; the cement is composed of a mineral assemblage belonging to the third stage; drill chamber 9, the southeastern wall. (f) Veinlets of barren quartz are crosscut by quartz-molybdenite veinlets, which, in turn, are cut by quartz-feldspar veinlets of the second stage and a late vein of the third stage; all veinlets are cut by a dike of olivine basalt; the fault extends along the hanging wall of the dike; drift 3, the southeastern wall.

alization is of the most economic importance. Veinlets in the stockwork vary from tenths of a millimeter to 10–15 cm thick (more often, 0.5–2 cm; occasionally, up to 25–35 cm). The thickness of the pinch and swell quartz-molybdenite veinlets is highly variable; they are tortuous and relatively short, varying from tens of centimeters to a few meters in length. This is a typical morphology of veinlets that fill tension cracks (Korolev and Shekhtman, 1965). However, the quartz-molybdenite veinlets developed along shear fractures are relatively rectilinear and consistent in thickness, extending for a few tens to hundreds of meters.

Quartz-molybdenite veinlets are nonuniformly distributed throughout the Tigriny stockwork and vary in number from a few to 40–50 per meter. The veinlets are

the most abundant in hornfels near the Minor granite porphyry stock. At the level of adit 5, irregularly shaped clusters of quartz-molybdenite veinlets (more than 30 veinlets per meter) are located around the Minor stock, at a distance of 50–100 m from its contact, being partially superimposed on its offsets. Toward the stock, the veinlets abruptly decrease in number. They still occur in the contact zone of the stock but are absent in its inner portion (Figs. 6, 7). Beyond the Minor stock, the quartz-molybdenite veinlets are aligned along the axis of the ore zone, making up local linear stockworks.

The orientation of the quartz-molybdenite veinlets is also controlled by the granite porphyry stock. Near the stock, the veinlets extend parallel to contacts, dip-

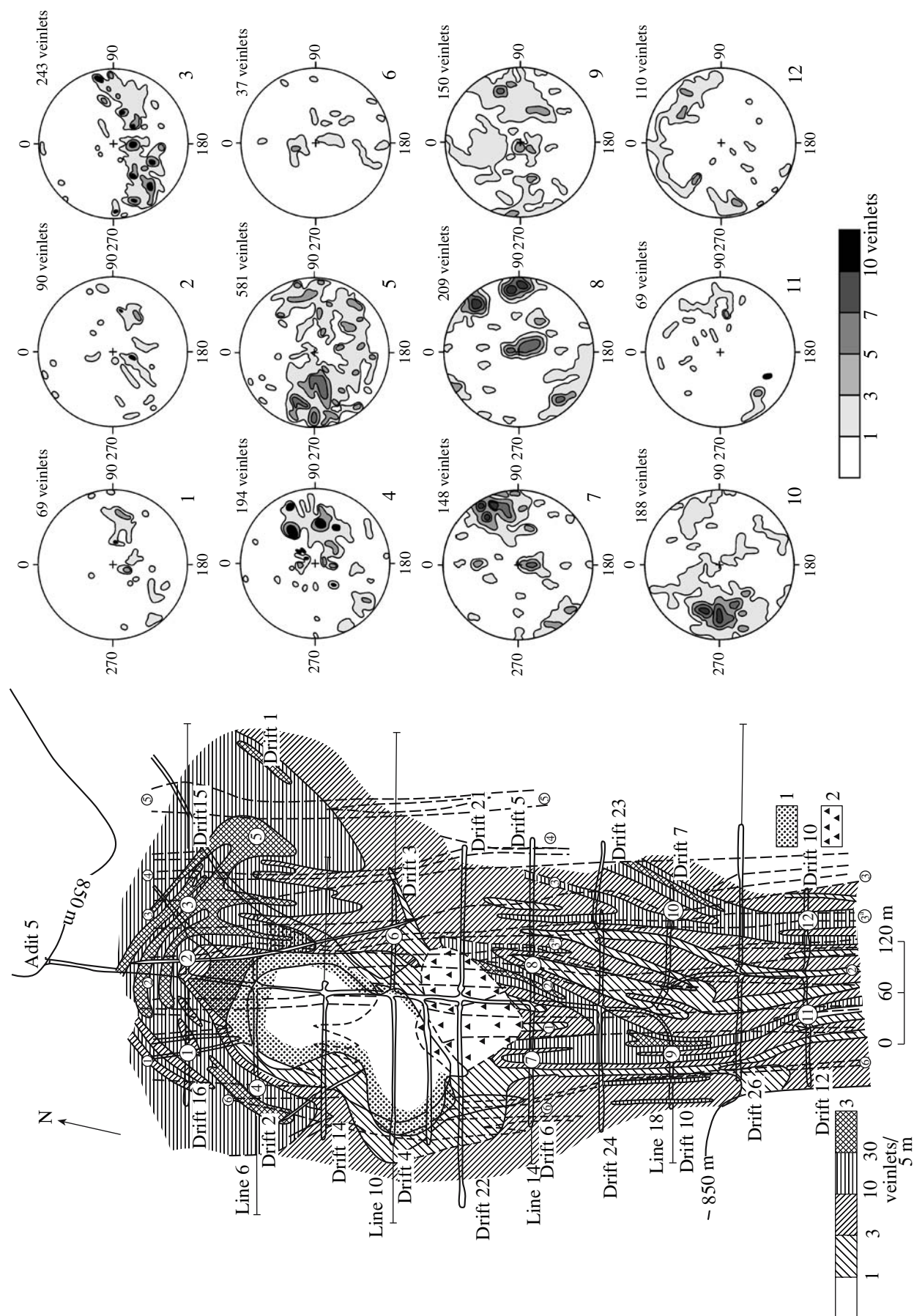


**Fig. 6.** Spatial distribution and orientation of quartz-molybdenite veinlets of the first stage in the Tigriny stockwork (level 850 m). Compiled by M.S. Schneider and A.A. Schneider. (1) Pockets and disseminated molybdenite mineralization in granite porphyry and pegmatoid rock; (2) molybdenum mineralization in fragments of hydrothermal breccia; (3) number of veinlets in the quartz-molybdenite stockwork.

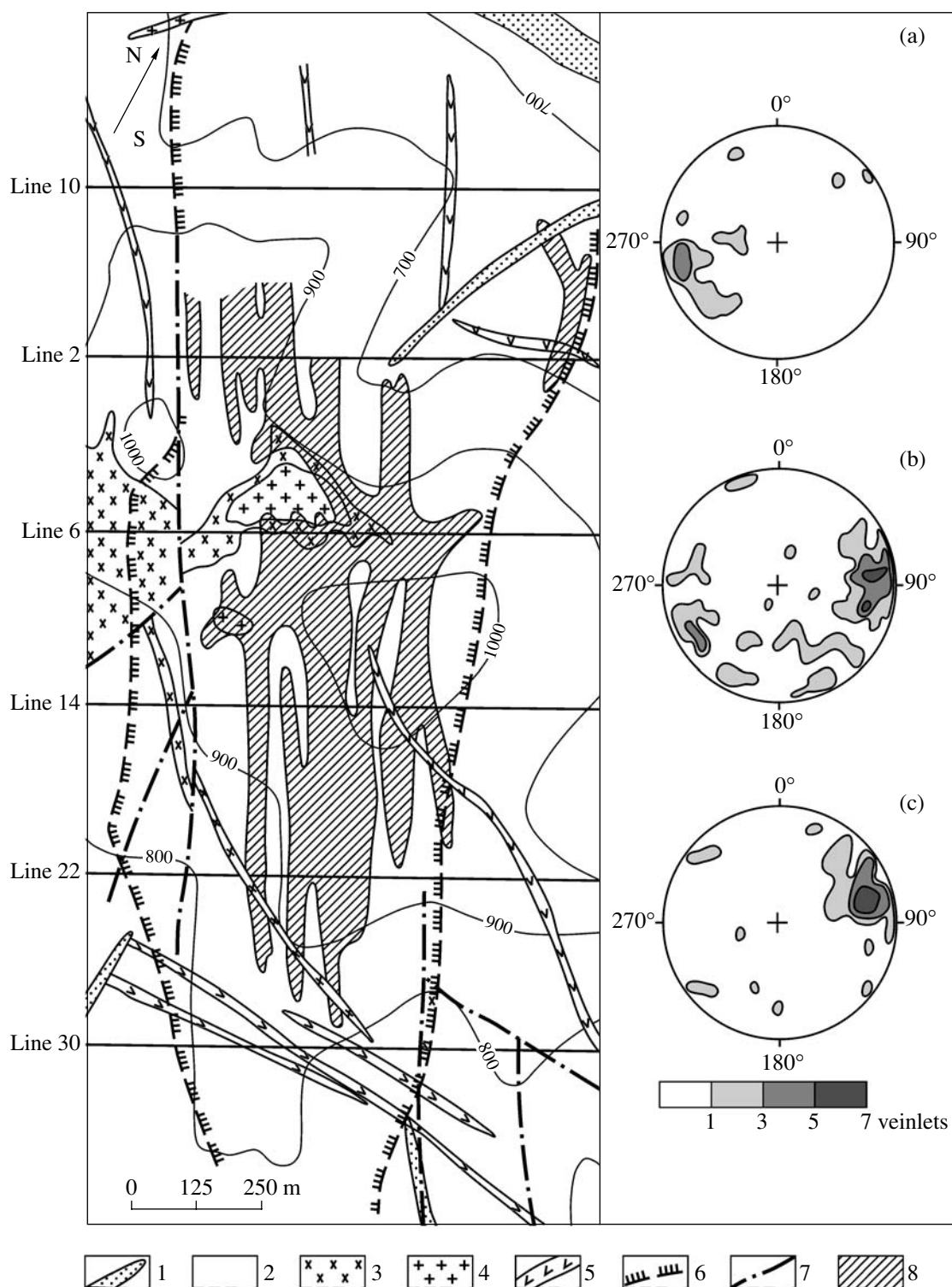


**Fig. 7.** Clusters of quartz and quartz-molybdenite veinlets and their orientation at the surface of the Tigriny stockwork. Compiled by M.S. Schnaider and A.A. Schnaider. (1) Alluvial sediments, (2) hornfels, (3) fine-grained leucogranite (dike and contact chilled zones of stock), (4) granite porphyry, (5) basaltic dike, (6) contours of ore zone, (7) fault, (8) cluster of quartz and quartz-molybdenite veinlets. (a–c) Diagrams showing orientation of veinlets: (a) in the northwestern part of the ore zone (to the northwest of Line 6); (b) in the middle part of the ore zone (between Lines 6 and 14); (c) in the southeastern part of the ore zone (to the southeast of Line 14).

ping mainly toward the stock (Fig. 6, diagrams 1–5). At a distance from the cupola, the veinlets are oriented parallel to the ore zone. At the level of adit 5, southeast of the Minor stock, the clusters of quartz–molybdenite veinlets extend in the axial part of the ore zone. The orientation of separate veinlets in clusters is controlled by the general strike of the ore zone, with dipping predominantly in the NE and less frequently in the SW directions (Fig. 6, diagrams 7–12). However, some veinlets dip toward the Minor stock.

A somewhat different situation is observed in the Main stock, located west of the Minor stock. The exposed apical portion of the Main stock consists of fine-grained leucogranite of the contact zone. According to the drilling results, this zone is as thick as 200 m. The abundance of quartz–molybdenite veinlets in the contact shell of the Main stock at the present-day erosion level and at a depth is higher by an order of magnitude than that in the contact shell of the Minor stock. As follows from the borehole sampling, the molybdenite abundance tends to decrease with depth. All these facts, as well as the distribution of molybdenite mineralization in the Tigriny stockwork, lead to the conclusion that the Main stock has been eroded to a much shallower depth than the Minor stock.

## CONCLUSIONS

The Tigriny deposit is a tin–tungsten–molybdenum deposit with complex ores. Molybdenum may be of economic interest as a by-product of mining.

The molybdenite mineralization at the Tigriny deposit is genetically related to the granite porphyry stock and was formed during four closely spaced and telescoped substages of the first ore stage: quartz (barren), molybdenite–quartz, pegmatoid, and autogreisen. The isotopic age of the first stage covers the interval from  $92 \pm 4$  to  $80 \pm 3$  Ma (Gonevchuk et al., 2006).

The substages listed above developed under different physicochemical, temperature, and dynamic conditions. The homogenization of fluid inclusions in quartz showed that the quartz assemblage ( $T_{\text{hom}} = 480\text{--}365^\circ\text{C}$ ) and molybdenite–quartz assemblage ( $T_{\text{hom}} = 420\text{--}300^\circ\text{C}$ ) crystallized from high-temperature silica-saturated pneumatolytic–hydrothermal solutions, which were enriched in molybdenum, bismuth, tellurium, and gold during the molybdenite–quartz stage. Minerals of the pegmatoid and greisen substages crystallized at a temperature higher than  $650^\circ\text{C}$  from a volatile-rich magmatic melt, a pneumatolytic melt–solution, which was saturated with molybdenum, bismuth, lithium, and selenium at the pegmatoid substage and with molybdenum, tungsten, tin, zinc, lithium, fluorine, arsenic, and copper at the greisen substage.

The data on the distribution of molybdenite mineralization in the Tigriny stockwork could be used in choosing areas for selective mining. Most molybdenite-bearing veinlets are distributed concentrically around the stock, at a distance of 50–100 m from its contact. This distribution is controlled by a system of tension cracks that surround the Minor stock in the form of a wide halo. Special attention should be paid to the apical portion of the Minor stock, which contains many more quartz–molybdenite veinlets than the Tigriny stockwork.

The formation of both molybdenum and tin–tungsten mineralization at the Tigriny deposit was a multi-stage process accompanied by a change of style of deformation. Systems of older, randomly oriented and younger, near-parallel veinlets are distinguished in the Tigriny stockwork. The former system bears molybdenite mineralization and the latter, tin–tungsten mineralization. The conformable greisen body, linear stockwork, hydrothermal breccia, and veins were formed over a relatively short time.

The Tigriny deposit clearly demonstrates the genetic links between the ore formation and the emplacement of the granitic intrusion. Ores different in age, composition, morphology, temperature, and geodynamic conditions were telescoped, giving rise to the formation of polyascendent (pulsed) zoning (Kutina, 1965).

A similar object with tin–tungsten mineralization is located 15 km northeast of the Tigriny deposit, in the Taborny ore field. This is the Stlanikovy prospect, whose geology, structure, geochemistry, and mineralogy allowed A.A. Schnaider and V.P. Leonov to recommend it in 1986 as a target for exploration.

In the light of the results of study of the molybdenum mineralization at the Tigriny deposit, we recommend continuing the prospecting and reappraisal of many areas fixed in the scheme of the extent of molybdenum mineralization (Fig. 1). The main efforts must be focused on the discovery of large-scale porphyry-type copper–molybdenum deposits related to the Mesozoic granites. So far poorly studied objects of the Ezop, Yam-Alin, Duse-Alin, and other ore districts of the Khyngan–Okhotsk and Upper Amur metallogenic provinces may be possible targets. The Mineev type of Au- and U-bearing molybdenum mineralization in the largest gold–uranium ore district of the Far East, the Central Aldan ore district (Boitsov et al., 2006), is of obvious importance.

## ACKNOWLEDGMENTS

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