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HYDROTHERMAL PHENOMENON ASSOCIATED WITH LAHOR PEGMATOID/GRANITE COMPLEX, KOHISTAN

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ABSTRACT

Pb–Zn–Mo and uranium mineralization spatially associated with Lahor pegmatite/granite complex and enclosing metasediments is examined in the light of new data on ore minerals. Several ore paragenetic associations are described and it is concluded that polyphase mineralization processes are responsible for the ore associations described.

INTRODUCTION

Pb–Zn and Mo mineralization associated with Lahor Pegmatoid/granite was first reported by Ashraf *et al.* (1980), whereas uranium mineralization near Thakot has been known for quite sometime and later studied in some detail by Butt *et al.* (1976, 1978).

The existence of several other ore minerals have been reported from the area. These include magnetite, chromite, chalcopyrite, baryte, magnesite. This study presents a synthesis of genetic and relative chronological relationships between ores and associated granitic and metamorphic rocks.

GEOLOGY

General geology of the Thakot–Besham area is described by Ashraf et al. (1980). Igneous and metamorphic rocks of the area represent the leading edge of the Indian continent underthrusting the Kohistan Island arc, resulting in the obduction of ophiolitic sequence along the main mantle thrust. The mineralizations described in this paper are related to igneous and metamorphic rocks immediately south of the main mantle thrust in Thakot–Besham area. Granites and metamorphic rocks make up the bulk of Thakot–Besham area. The granitic rocks include Lahor granite/pegmatoid complex of possible Precambrian age, Shang granite gneiss and Mansehra granite gneiss. Metamorphic rocks of the area have been variously correlated with the "Salkhala formation", "Tanawal formation" and poorly defined "Thakot metasediments" (see Ashraf *et al.*, 1980).

MINERALIZATIONS

The igneous–metamorphic zone immediately south of the main mantle thrust contains a varied assemblage of ores. The following associations of genetic significance have been distinguished in the area:

1. Magnetite – Baryte.
2. Magnetite – Baryte – Fluorite – Pyrite.
3. Scheelite – Molybdenite.
4. Molybdenite – Pyrrhotite – Pyrite – Galena – Sphalerite.
5. Sphalerite – Pyrite.
6. Sphalerite – Pyrite – Galena.
7. Sphalerite – Pyrite – Melnikovite – Galena.
8. Pyrite – Pyrrhotite – Uraninite – Chalcopyrite – Galena.
9. Pyrite – Galena – Uraninite.
10. Crystalline Magnesite – Talc.
11. Baryte – Marble.

Magnetite – Baryte association :

This association occurs in skarns at several locations. In general these bodies are small in size but a few bodies in Pazang and Lahor are of considerable dimensions. It may be pointed out here that small bodies of magnetite are also encountered within the granite which shows magmatic segregation features.

Mineralogically these occurrences have been further classified into the following variations by Ashraf *et al.* (1980).

1. Magnetite carbonate skarns which contain 12–80% magnetite with quartz, carbonate, limonite, amphibole, garnet, baryte, pyrite, fluorite and baryte.

2. Magnetite – Silicate skarns which contain 50–95% magnetite with diopside, amphibole, antigorite, carbonates, quartz, hematite, limonite and barite.

Scheelite – Molybdenite association :

Scheelite – Molybdenite association is encountered in altered granitic and pegmatitic rocks. In Ghaus Banda area a transition from altered granite to molybdenite-bearing wall rock occurs through a zone of pyrite. In this zone molybdenite occurs as joint fillings in diopside-carbonate skarns. In addition to scheelite and molybdenite as vein fillings, a zone of dissemination of these minerals is also observed. Mineralogically this zone is simple. It contains coarsely crystalline pyrite veins invading the skarn bodies which contain vein molybdenite and traces of scheelite. A distinct lack of chalcopyrite is characteristic of this zone which suggests the possibility of high silver content of galena in late hydrothermal stage.

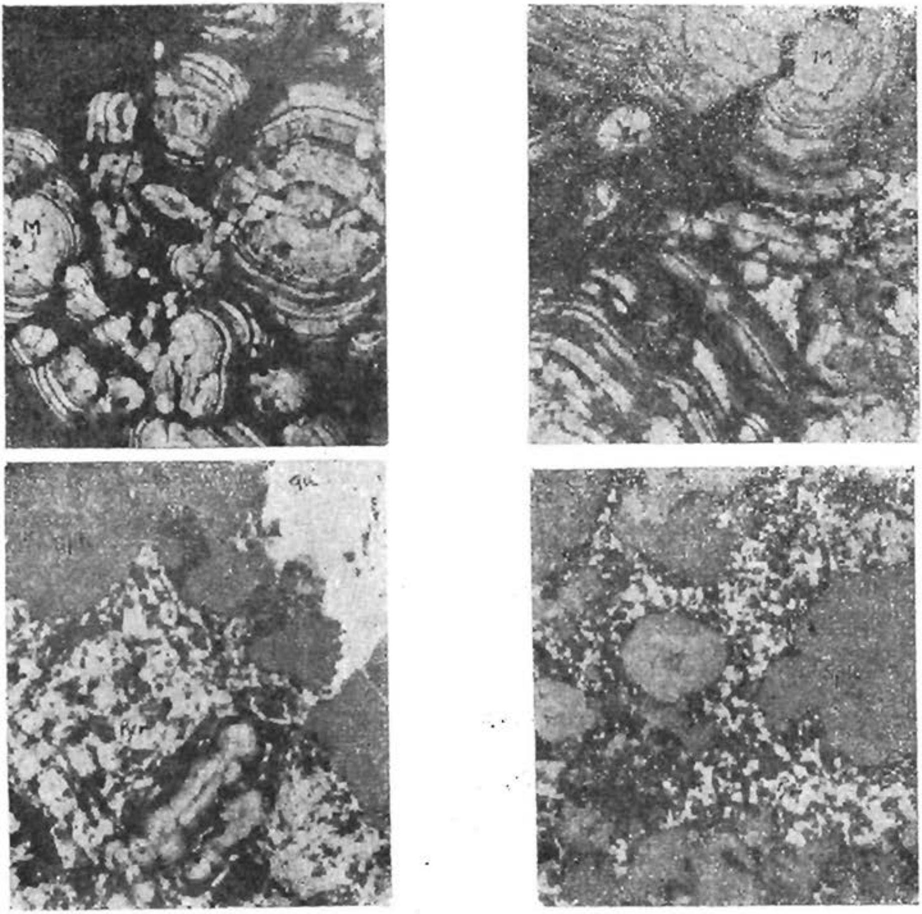
Molybdenite – Pyrrhotite – Pyrite – Sphalerite association :

Scheelite – Molybdenite association imperceptibly grades into a zone of a relatively complex mineralogy. This zone is characterized by the appearance of pyrrhotite, and sphalerite. These occur both as veinlets and dissemination in the skarns. Such an association is restricted to the country rocks and never encountered within the granitic rocks.

Sphalerite – Pyrrhotite – Pyrite association :

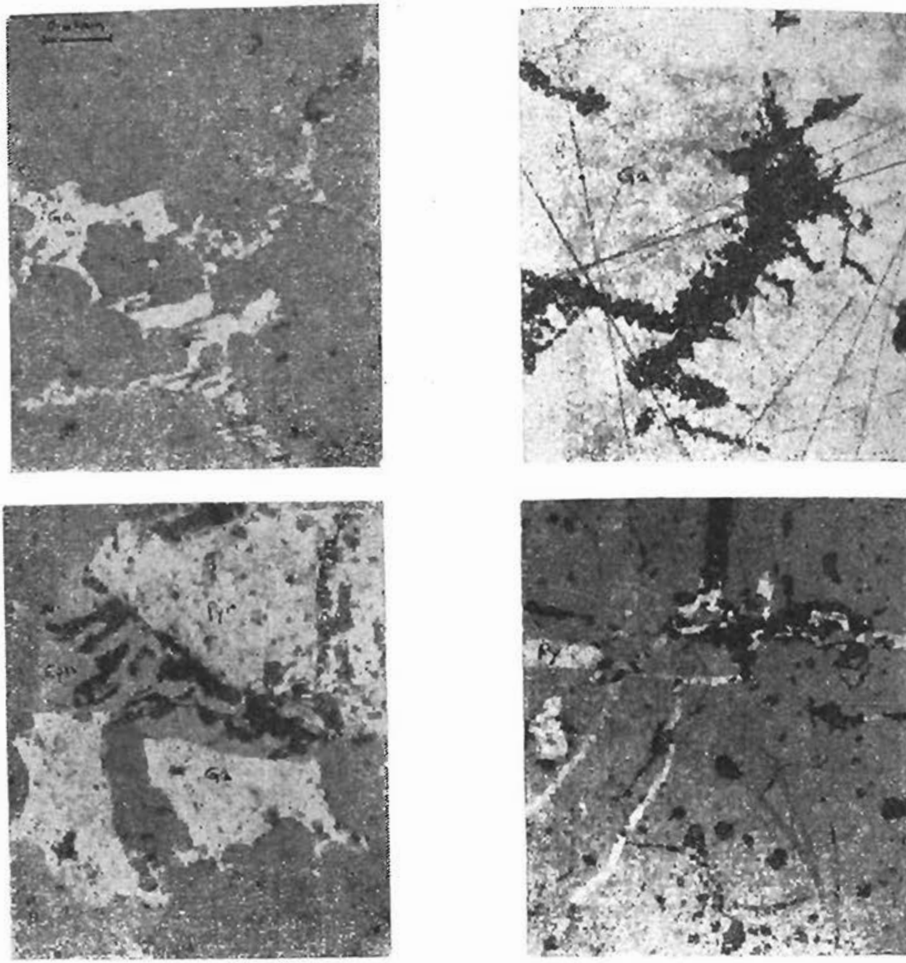
Moving away from molybdenite-bearing zone one enters into an assemblage which lacks this mineral and the resulting pargenesis consists mainly of sphalerite – pyrrhotite and pyrite, (Plate **1** d).

PLATE I



Top left and right: Concentric ring of Melnikovite (M).
Bottom left: Galena with characteristic triangular pits.
Bottom right: Rounded & corroded grains of sphalerite with pyrrhotite.

PLATE II



Top left: Galena precipitated along the grain boundary.
Top right: Sphalerite (dark grey) deposited along cleavage in Galena.
Bottom left: Galena with little gangue inclusion, sphalerite and pyrrhotite with gangue inclusion.
Bottom right: Veins of pyrite (Py).

Sphalerite – Pyrite – Galena association :

Further away from the molybdenite-bearing altered granite and molybdenite veins, disappearance of pyrrhotite marks a new ore mineral assemblage. The ore association now consists of veins and disseminations of sphalerite, pyrite (Plate II d) and galena. Galena (Plate I c) is the new mineral which occurs as crosscutting veins as well as along the grain boundaries (Plate II a). Galena is absolutely free of inclusions as compared to sphalerite and pyrrhotite of the ore association described earlier (Plate II c).

Sphalerite -- Pyrrhotite – Melnikovite – Galena association :

The appearance of Melnikovite (Plate 1 a, b) makes this assamblage. This mineral is characteristic of being low temperature and its crystallization in this rock represents very late stage of hydrothermal acitvity. At places melnikovite recrystallizes into pyrite indicating a post-ore thermal event in the area. This association also contains sphalerite crystallized along the cleavage planes of galena (Plate II b) which suggests a possible second generation of sphalerite compatible with low temperature assemblage.

The ore association so far described represents a cross section across an altered granite containing molybdenite, like that in Derai/Pazang areas. A paragenetic diagram, based on spatial and textural relations of various ore, is given in Fig. 1.

Pyrite – Pyrrhotite – Uraninite – Chalcopyrite – Galena association :

In area of Pb–Zn–Mo mineralization near Besham, i.e. Lahor and Pazang, few uranium occurrences have been reported. Areas of base metal and molybdenum mineralization lack uraninite. Further south near Thakot, vein type uranium mineralization has been described by Butt *et al.* (1978). This association contains pyrite as the principal ore mineral in the form of fine veinlets and interstitial fillings within the pegmatoid as well as associated biotite-garnet schists. Occasionally it also occurs as coating on the pyrrhotite grains. Pyrrhotite occurs as tabular crystals occasionally replaced by pyrite. Uraninite is generally as rounded grains which are strongly porous and are interspersed and encased with pyrite. Others include rare chalcopyrite and galena.

Pyrite – Galena – Uraninite association :

The ores are mainly deposited in the cracks of the rock and along grain boundaries of the silicate minerals. The principal ore mineral is pyrite; galena is very rare, it forms up to 50 micron tabular crystals which are diffusely distributed in the rock. Associated with the pyrite are roundish, 200 micron uraninite grains which appear to be very porous, possibly due to leaching effect.

Alteration phenomenon related to uranium vein formation has been studied by Butt *et al.* (1978). A summary of alteration due to uraniferous veins is given in Fig. 2.

Crystalline Magnesite – Talc association :

Veins containing up to 98% coarsely crystalline magnesite have also been encountered in the area. These vein are restricted to the metasediments which contain very little pegmatitic or hydrothermal vein activity. These veins range in

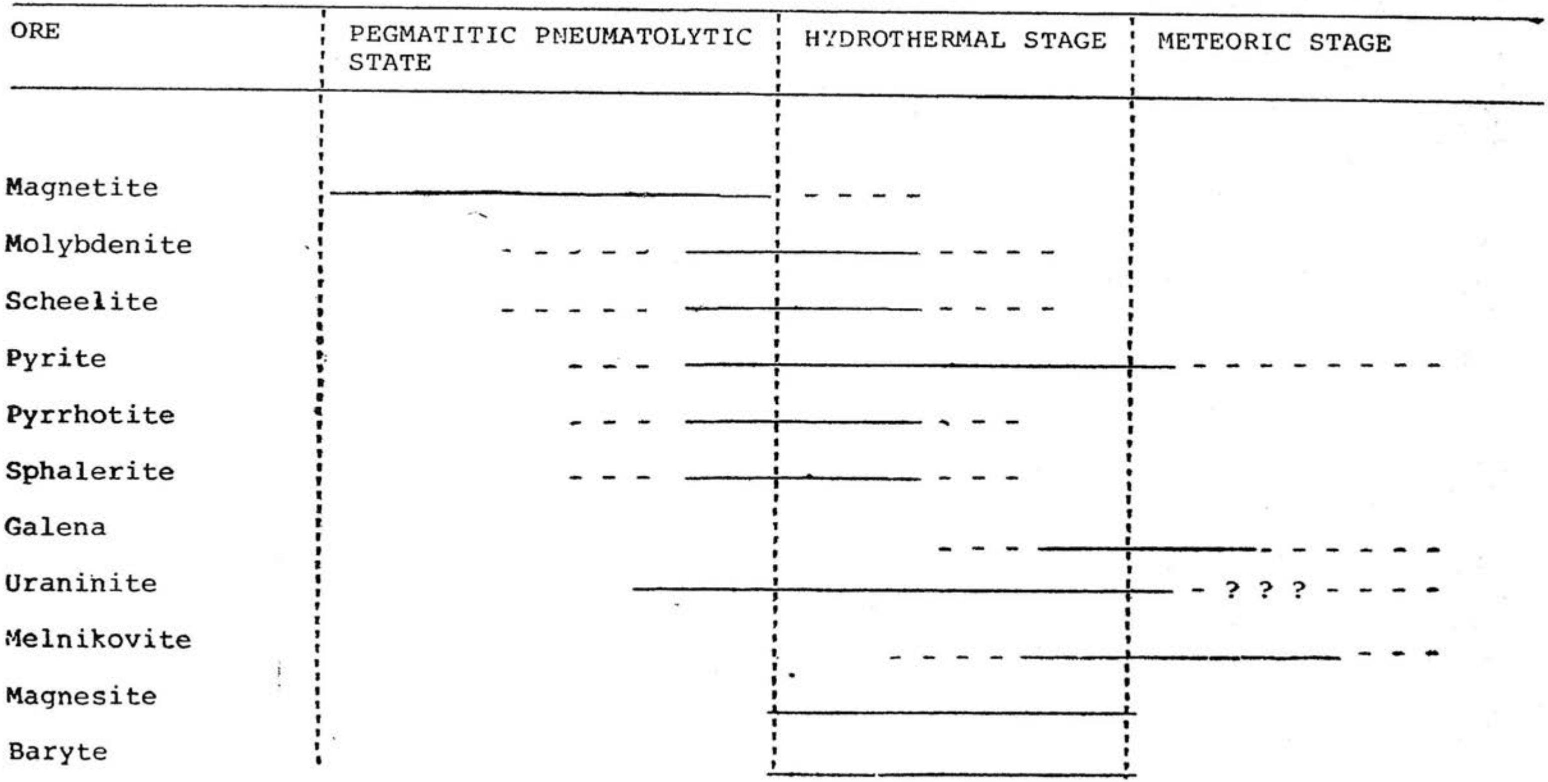
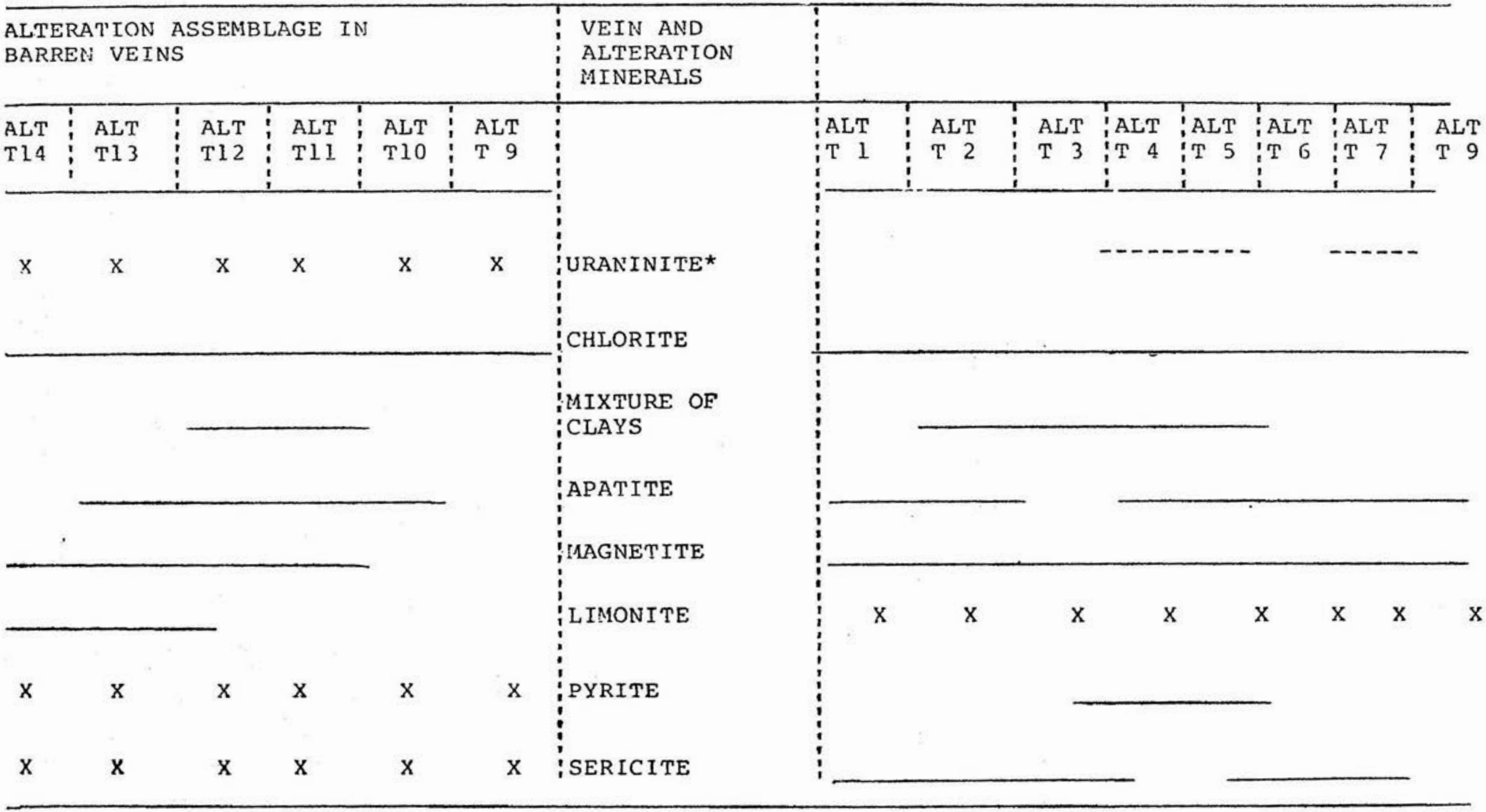


Fig. 1 Paragenetic diagram of mineralization in Besham/Thakot area.



* Identification of Uraninite by XRD

Fig.2. A comparison of alteration assemblage in uraninite bearing and uraninite free veins

width from a few meters to 200 meters and are in turn cut by calcite veins. The margins of these veins contain talc which is highly sheared, whereas the main body of the vein shows no effect of deformation. The localization of these veins seems to be along the areas where faults or master joints have cut through a lithology appropriate for its conversion to crystalline magnesite under the influence of hydrothermal solution. Association with talc suggests that it is formed by breakdown of talc/serpentine by hydrothermal carbonate solutions and later recrystallization.

Witherite – Baryte – Marble association :

Their occurrence is similar to that of Magnesite. The occurrence of baryte as gangue mineral with magnetite mineralization in skarns as well as the ubiquitous association of baryte veins with marble suggest the role of hydrothermal activity in their formation.

DISCUSSION

The ore mineral assemblages described above are spatially associated with granite/pegmatoid complex near Thakot – Besham area. All these occurrences are thought to be formed by some sort of hydrothermal phenomenon related to pegmatoids and granitic rocks of the so called "Lahor granite". A detailed mapping (Nasir, personal communication) indicates that the so called Lahor granite is dominently pegmatitic with minor granitic facies. In Lahor Pazang area molybdenite and base metal sulphide mineralization is spatially and genetically associated with altered granites and pegmatoids. A complete zonation from a molybdenite-bearing core in altered granite to a "pyrite halo" grading into vein type Pb–Zn mineralization is established in this study. It must be pointed out that in Thakot–Besham area, the present spatial distribution of these zones can only be established at individual localities since the regional picture of mineral zonation is complicated by syn–and post-mineralization deformation. This type of zoning is similar to that described by Peters *et al.* (1966).

The sulphide skarn, banded replacement zones, veins and impregnations spatially associated with pegmatoid bodies are not associated with uraniferous vein mineralization near Thakot. Chronologically later uranium mineralization is localized exclusively by a joint system both in pegmatoid as well as the country rock (Butt *et al.,* 1978). This is in contrast to the Pb–Zn–Mo sulphide mineralization where in addition to vein fillings, disseminations and replacement type structures along the contact of pegmatites suggest a relative chronological contemporaneity. Such a time gap between sulphide mineralization and uraniferous veins has been described from Great Bear lake district N.W.T. of Canada by Robinson and Badham (1974), Robinson and Ohmoto (1973) and Badham *et al.* (1972). The relationship of crystalline magnesite and baryte veins to either Pb–Zn or uraniferous vein mineralization is difficult to establish. However, the formation of baryte during the introduction of magnetite in the skarn suggests that the phenomenon may be related to the late stage of Pb–Zn mineralization. The formation of skarns at the granite/pegmatoid contact must have produced carbonated hydrothermal fluids which were responsible for the formation of magnesite through replacement of pre-existing ultramafic rocks or siliceous dolomites.

Thus the final metallogenetic picture that emerges is:

a. An early intrusion/anatectic formation of Lahor granite/pegmatoids complex.

b. Magnetite and Pb–Zn–Mo mineralization in skarns, banded replacement zones, veins and impregnations.

c. Late stage hydrothermal activity along major faults and fracture system to form replacement magnesite from the breakdown of talc/serpentine etc. through action of carbonate hydrothermal solutions.

d. Uraniferous vein formation as late joint fillings.

From the above, it is suggested that the Lahor granite/pegmatoid complex may represent a polyphase intrusive/anatectic activity resulting in chronologically distinct ore associations. Detailed petrological studies are required to support or reject this hypothesis.

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