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# TITANCLINOHUMITE FROM THE WICHITA MOUNTAINS, OKLAHOMA

W. T. Huang, *Geology Department, Hardin-Simmons University, Abilene, Texas.*

Significant megascopic quantities of titanclinohumite have been identified in two rock specimens presented by J. V. Smith, a local ranger, found near the U.S. Post Office at Meers in 1950, when the writer first visited the gabbro-granophyre complex of Precambrian age in the Wichita Mountains of southwestern Oklahoma. Later, in 1952, titanclinohumite was again found in magnetite gabbro and troctolite at Iron Mountain, Sec. 28, T.4N., R.16W, and a diallagite exposure six miles northwest of Meers, NW¼, Sec. 30, T.4N., R.14W., while the writer undertook the investigation of the Wichita Mountains igneous complex.

The gabbroic rocks at Iron Mountain and diallagite in the area six miles northwest of Meers are contaminated with granitic materials and veined with pegmatites, as both localities lie in the contact zone between gabbro and granophyre of the igneous complex. The ramifying quartzofeldspathic veinlets, stringers, and pegmatite patches are flecked by small black titanclinohumite grains. Many blackish brown titanclinohumite grains are sparsely distributed in the diallagite, and at Iron Mountain brown titanclinohumite is admixed with olivine crystals both in magnetite gabbro and troctolite.

Alteration is pronounced in the gabbroic rocks, and the severe alteration could not be attributed to atmospheric weathering alone. The distribution of alteration products is patchy and irregular, as if caused by a granophyric melt and volatiles which migrated through the rocks and altered the minerals in their paths. Olivine is altered to iron minerals. Plagioclase has been partly replaced by aggregates of prehnite. The aggregates form irregular patches and are associated with chlorite, zeolite, and iron ores. Alteration of augite indicates a tendency to form palegreen tremolite, prehnite, biotite, and chlorite. From the foregoing description it is likely that formation of the titanclinohumite is due to contact action of granophyric melt containing fluorine upon gabbroic rocks. The mineralogy of the two specimens collected by Smith is significant and support the view just set forth.

The first specimen, 3″×5.5″ in size, is gabbroic in composition, medium-grained, brecciated, and altered. Titanclinohumite grains ranging from 4.5 mm. to about 1 mm. in diameter, are irregularly distributed in the rock, and make up about 18 per cent. They are associated with such contact metamorphic minerals as phlogopite, spinel, garnet (grossularite) diopside, and epidote. Undoubtedly these minerals have been developed by contact action of granophyric melt upon the gabbroic rocks.

The second specimen, 2″×4.5″ in size, is a medium-grained mixed rock, probably granogabbro, and exhibits peculiar pseudodiabasic texture. Separate crystals of calcic feldspar and pyroxene are associated with such magmatically incongrous minerals as quartz and alkalic feldspar. Both textural and mineralogical characters of the specimen strongly point to the striking resemblance of the "intermediate rock," which occurs as a narrow zone between gabbro and granophyre in the Wichita Mountains (Huang, 1955). Only a few titanclinohumite grains ranging from 2 mm. to 2.8 mm. in diameter, were found in this specimen. But they are associated with a few small euhedral cassiterite, grossularite, and diopside crystals. Thus, the titanclinohumite grains are accompanied by minerals commonly found in contact zone of intruded igneous rocks.

All the titanclinohumite grains identified are anhedral, without twinning; some have imperfect cleavage. Hardness ranges from 6 to 6.5; it is somewhat brittle. Fracture is subconchoidal to uneven. The specific gravity is 3.34. The mineral is commonly black in color, but due to alteration it may be blackish, black brown, passing into brown. The luster is subvitreous and slightly resinous.

$X$-ray studies both by Laue and rotation methods showed this titanclinohumite to be monoclinic, with $\beta = 101°44'$. The unit cell dimensions are: $a_0 = 13.63$ Å, $b_0 = 4.80$ Å, $c_0 = 10.12$ Å.

Optically this mineral is biaxial with $(+)2V_D = 52°–57°$. Indices of refraction for D light at 25° C. are: $\alpha = 1.702$, $\beta = 1.709$, $\gamma = 1.728$. Inclined dispersion is weak to distinct. Pleochroism is imperceptible.

Partial data of chemical analysis from titanclinohumite specimen collected at Iron Mountain are: $TiO_2$ 2.45%, $Fe_2O_3$ 1.20%, FeO 11.25%, F 1.02%, $H_2O^+$ 1.05%. Table 1 shows the spectrographic results. Sr, Ni, Cr, and Co were determined by mixing one part of sample with two parts of graphite buffer and arcing 10 mgs. of the mixture to completion in a platform electrode at 16 amperes. Cu, Pu, and Ga were measured with centerpost electrodes at 8 amperes (DC arc). Arcing was terminated after the sodium burning was completed, usually 60–62 seconds for a 10 mg. sample.

TABLE 1. SPECTROGRAPHIC ANALYSES

| Locality | Specimen | Sr | Cu | Cr | Ni | Co | Pb | Ga |
|---|---|---|---|---|---|---|---|---|
| IM | Titanclinohumite* | 0.10% | 0.01% | — | ~0.008% | — | — | — |
| 6NW | Titanclinohumite | .07 | .01 | — | — | — | — | — |
| 6NW | Titanclinohumite | .03 | .005 | 0.01% | .1 | — | — | — |
| IM | Olivine | .07 | .005 | — | — | — | — | — |
| 6NW | Olivine | .01 | .0005 | — | .1 | — | — | — |

IM—Iron Mountain; 6NW—6 miles northwest of Meers.

Dashes indicate amounts near or below limits of detection but without marked variation, as follows: Ni 0.008%, Cr 0.01, Co 0.0036, Pb 0.0025, Ga 0.002.

* Chemically analyzed titanclinohumite.

Although the spectrographic analyses indicate clearly that the same trace elements are present in the titanclinohumite and the associated olivine crystals, and the mineral is found in mafic, ultramafic, and mixed rocks, there is no evidence that this titanclinohumite was derived from olivine by deuteric alteration. Absence of residual grains of olivine surrounded by or related to titanclinohumite and the fact that the alteration of olivine in the area studied commonly has led either to the formation of coronas or to the selective replacement by late iron minerals (Huang, 1954), argue against the genetic relationship between olivine and titanclinohumite. In view of the mineralogy, lithology, and textural features found in the specimens collected by Smith and the field occurrence of the titanclinohumite in the Wichita Mountains already described, it is believed that this titanclinohumite may have been developed by contact action on gabbroic rocks of a granophyric melt containing fluorine.

The writer wishes to express his appreciation to Mr. J. V. Smith for the specimens that he contributed to this investigation, and to Mr. Earl Smith, graduate student at the University of Oklahoma, who assisted the spectrographic analysis of the titanclinohumite in the magnetite gabbro collected at Iron Mountain.

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