SHORTER COMMUNICATIONS

SYNTHESIS OF BRANNERITE[1]

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Brannerite is generally believed to be one of the uranium-bearing minerals in the conglomerates of the Blind River area of Ontario. Since the mineral is metamict and fine-grained, identification is difficult, and has been based mainly on *x*-ray diffraction patterns of heat-treated material. Some geologists are not convinced of the presence of brannerite in these ores: they theorize that under the ignition conditions employed to recrystallize a metamict mineral, chemical or structural changes may take place which result in a compound with the structure of brannerite being formed artificially from a uranium-titanium mineral in the ore or from a mixture of two minerals (A. H. Lang (1956): Our uranium resources: *Can. Min. J.* **77**, No. 6, 73.)

Laboratory experiments were therefore undertaken in order to determine whether a compound with the structure of brannerite could be synthesized from the oxides of uranium and titanium under the usual ignition conditions. When this proved unsuccessful, further tests were made to determine the conditions necessary for the synthesis, and to establish thereby the ideal composition of brannerite.

Weighed amounts of the oxide reagents were ground together in an agate mortar to ensure thorough mixing. The charges were heated under controlled atmosphere and temperature conditions in a high frequency furnace or in a Pt/Rh resistance furnace, except in the initial tests at 1000°C, where a Meker burner was used. Argon, where used for an inert atmosphere, was drawn from a cylinder and passed through a tube containing heated copper turnings to remove any traces of oxygen. The heated charges were cooled slowly to room temperature and the crystalline phases in the products were determined by *x*-ray diffraction analysis.

In preliminary tests, charges consisting of TiO_2 and UO_2, TiO_2 and U_3O_8, and TiO_2 and UO_3 were heated at approximately 1000°C in air, argon and vacuum. No interaction between the oxides took place, thus indicating that a synthetic compound could not be formed from U-Ti

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minerals under standard ignition conditions. The fortuitous presence of fluxing agents, such as calcium compounds, might well serve to catalyze the reaction and indeed such was found to be the case, but at a considerably higher temperature.

Charges consisting of UO_2, U_3O_8, or UO_3, and TiO_2, in the molecular proportion $UO_2/TiO_2 = 1:2$ and 1:2.5, heated in argon at 1400°C for 90 minutes, all yielded sintered products which contained a brannerite-like phase as the major component. Little or none of this phase was produced when the charges were heated in air. Examination of polished sections under the microscope showed that the products of charges in which the molecular ratio was 1:2 were homogeneous, except for trace amounts of unreacted material, whereas the 1:2.5 products contained considerable proportions of a second phase. Comparison of the x-ray powder patterns showed that the synthetic 1:2 compound was isostructural with heat-treated brannerite and that the two materials had closely similar unit cells; minor differences in the position and intensity of the diffraction lines were probably due to the presence of Ca, Th, rare earths, Pb and other ions substituting for U in the structure of the mineral. A homogeneous sintered compound, UTi_2O_6, isostructural with the complex oxide mineral, brannerite, has thus been pyrosynthesized in argon.

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A concurrent investigation of the synthesis of brannerite at the University of Toronto was brought to the author's attention by a paper presented at the Annual Meeting of the Mineralogical Association of Canada, in April 1959, by Mr. J. Patchett. Mr. Patchett reported that a compound of the same composition had been produced by fusion in an arc furnace under an inert atmosphere.

IDENTIFICATION OF PLAGIOCLASE BY FUSION TECHNIQUE[1]

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Introduction

Additional investigations have been made by personnel of the Petrography Section into techniques for the economical and efficient fusion of

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