

carnegieite. On the other hand, no writer is justified in completely ignoring a convention that is already well established, as the industrial chemists have done in naming their petroleum derivatives "petrochemical," when, as nearly everybody knows, petrochemistry is the chemistry of rocks.

As an alternative for the benefit of any reader who wishes to stand firmly on the mineralogist's principle, I suggest that he call Coes' new phase of silica *silica C* and that he call Keat's phase *silica K*.

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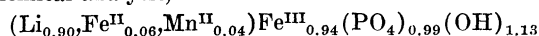
Received April 8, 1954.

### Tavorite and Barbosalite: Two New Phosphate Minerals from Minas Gerais, Brazil

Two more new phosphate minerals—tavorite and barbosalite—have been discovered in the Sapucaia pegmatite mine in Minas Gerais, Brazil. Three other minerals, recently described in the mineralogical literature, were named frondelite, faheyite, and moraesite. The Sapucaia permatite is granitic in composition, is confocally zoned on the basis of texture and mineral composition, and has had a significant production of muscovite and beryl.

Tavorite and barbosalite are intimately intergrown secondary phosphate minerals that occur with many other phosphate minerals in the pegmatite: heterosite, ferrosicklerite, hureaulite, vivianite, strengite, metastrengite, childrenite, variscite, frondelite, faheyite, moraesite, triphylite, montebrazite, and apatite. Other accessory minerals include spodumene, beryl, tourmaline, and sulfides. Quartz, perthite, albite, and muscovite are the essential minerals of the rock.

Tavorite is a hydrous lithium ferric phosphate, the ferric analog of montebrazite with which it is isostructural. It is named in honor of Elysiario Tavora, professor of mineralogy, Universidade do Brasil, Rio de Janeiro. The mineral occurs as a yellow very fine grained aggregate with a mean index of refraction of 1.807 and a specific gravity of 3.29. The chemical analysis shows the following percentages:  $\text{Li}_2\text{O}$  7.64,  $\text{FeO}$  2.39,  $\text{MnO}$  1.47,  $\text{Fe}_2\text{O}_3$  42.57,  $\text{P}_2\text{O}_5$  39.78,  $\text{H}_2\text{O}^+$  5.76, and  $\text{H}_2\text{O}^-$  0.40. The formula, as derived from the chemical analysis, is



as compared with the ideal formula  $\text{LiFe}(\text{PO}_4)(\text{OH})$ . X-ray powder data show principal  $d$ -spacings at 3.045, 3.285, 4.99, 4.68, and 2.474 Å.

Barbosalite is a hydrous ferrous ferric phosphate, the ferric analog of scorzalite. It is named in honor of A. L. de M. Barbosa, professor of geology, Escola de Minas, Minas Gerais, Brazil. The mineral occurs in black nearly opaque grains and masses that may be very fine grained aggregates. Thin grain edges are dark blue-green with evident pleochroism. The apparent mean index of refraction is 1.810, and the specific

gravity is 3.60. The chemical analysis, recalculated to 100 percent after subtracting admixed tavorite, is  $\text{FeO}$  13.12,  $\text{MnO}$  2.82,  $\text{Fe}_2\text{O}_3$  41.70,  $\text{P}_2\text{O}_5$  37.54, and  $\text{H}_2\text{O}$  4.92 percent. Its ideal chemical formula is  $\text{Fe}^{\text{II}}\text{Fe}^{\text{III}}(\text{PO}_4)_2(\text{OH})_2$ . X-ray powder data indicate principal  $d$ -spacings at 3.361, 3.313, 4.84, 3.239, 3.160, and 2.327 Å. The mineral is structurally identical with a synthesized compound described by Gheith as ferrous ferric lazulite and both are closely related to, but have a larger cell size than, scorzalite.

Tavorite and barbosalite are examples of complete substitution of trivalent iron for aluminum in known mineral structures.

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Received April 27, 1954.

### A Simplified Method for Determining Radioisotopes in Tissues

Several years ago, Schwebel, Isbel, and Karabinos [*Science* 113, 465 (1951)] described a method for the measurement of  $\text{C}^{14}$  labeled carbohydrates, dissolved in pure formamid; this served primarily as a medium of low vapor pressure usable in a modified flow gas counter. During a current study of the distribution in the body of a group of beta-emitting colloids ( $\text{Au}^{198}$ ,  $\text{CrPo}_4$ ,  $\text{Y}^{90}$ ), it became necessary to have a method that would make possible rapid disintegration of entire organs of moderate-sized animals and of the entire bodies of smaller species. Formamid, even when hot, does not effect such solution directly, but we have found that when it is added to freshly prepared homogenates of animal tissues, a clear colloidal solution results even at room temperature. Such a solution may be rapidly liquid-counted at infinite thickness employing the usual end-window Geiger tube.

There is no need for prolonged acid or alkali digestion of tissues or evaporation of assay samples. As a result, there is a marked saving of time, and data can usually be completed on the same day the animals are sacrificed.

The method is equally applicable to gamma-emitters since the 50-percent formamid can be pipetted easily in the small volumes required for well types of scintillation tubes.

Organs that may be broken down in the Potter-Elvehjem homogenizer are so treated, in the presence of 10 to 100 ml  $\text{H}_2\text{O}$ . Larger samples and small animals are first broken up in a Waring Blendor, and a suitable aliquot put through the Potter-Elvehjem. We have found it advisable to pour, rather than pipette, 10-ml samples of this homogenate into graduates or volumetric flasks and to add an equal volume of formamid, with measurement in 30-ml beakers, at constant distance from the counting tube. An inexpensive and portable rate meter, such as the 1615 B, or a comparable instrument, has served adequately, and the direct readings again facilitate the running of a large num-

ber of samples. At the time of the animal injection, a duplicate sample of the colloid is prepared in water and serves as the standard for all subsequent measurements.

In case considerable skin is present, a small lump of hair will remain which may be filtered on cheesecloth and warmed with formamid; this procedure serves to extract any activity present. Since formamid is a good fat solvent, the presence of lipids does not present any problem. Only in the case of large bony structures is it necessary to resort to the much more cumbersome and hazardous  $\text{HNO}_3$  digestion.

The method has been found to give values showing a strictly linear relation with respect to activity present. Standard deviations from average calculated values were  $\pm 2.2$  percent for  $\text{P}^{32}$ ,  $\pm 1.9$  percent for  $\text{Y}^{90}$  and  $\pm 3.1$  percent for  $\text{Au}^{198}$ .

A complete description of the method will appear in *Nucleonics*.

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Received January 11, 1954.

## Mapping Shallow Horizons with the Reflection Seismograph

The reflection seismograph has long been the standard in geophysical exploration for oil, because some types of geologic structure can be mapped with this instrument with rather high precision. Until recently, however, the seismic reflection method has not been used in shallow structural and depth-to-bedrock investigations, partly because of instrumental difficulties and partly because the petroleum industry, which has provided the stimulus for improvement in seismic exploration, has been interested primarily in finding deep structures and stratigraphic traps. For shallower studies, in the depth range from the surface down to about 1000 ft, core drilling, the refraction seismograph, and electric-resistivity methods have been widely employed.

Reflection seismic instruments, specially constructed for the U.S. Geological Survey, have recently been successfully tested in two areas in Oklahoma and Kansas. Near Ponca City, Okla., in Osage County, the Neva limestone has been successfully mapped at a depth of about 200 ft. Near Lyons, in Rice County, Kan., the Stone Corral dolomite has been mapped at depths of 150 to 200 ft. In addition, the base of the overburden at a depth of less than 100 ft has been mapped in some places in the Kansas test area. Reflection times as small as 30 msec have been measured. In the Oklahoma test area, reflecting horizons have been mapped continuously from 200 ft to depths as great as 4000 ft. [For an example of shallow-reflection mapping at somewhat greater depths, see C. F. Allen, L. V. Lombardi, and W. M. Wells, *Geophysics* 17, 859 (1952)].

The instruments, designed by the Midwestern Geophysical Laboratory in close consultation with Survey geophysicists, are not radically different from conven-

tional reflection seismic equipment. They have the following characteristics:

1) The frequency range of the 12 amplifiers is from 75 to 300 cy/sec (usually it is from 20 to 100 cy/sec).

2) The automatic volume-control time constant has been reduced to about a third of its usual value, and a variable presuppression control has been installed to permit a sharp reduction of the first energy arrivals.

3) The oscillograph paper speed has been increased from about 12 to 25 in./sec; high-frequency galvanometers have been installed, and the timing-line interval has been reduced from 10 to 2 msec.

The instruments can be used with or without automatic volume control and presuppression, and they are fully convertible to conventional operations by a simple amplifier exchange and a few oscillograph modifications. Reflected energy can be recorded almost immediately after the first arrivals.

In the Oklahoma test area, spread distances from the shot point of 100 to 210 ft between the first and twelfth geophones were used, and shots averaging 2 oz of dynamite were fired from shot holes drilled to the base of the "weathered" layer. A few single air shots were fired, but the record character was inferior to that for the hole shots. In the Kansas test area, spreads of from 20 to 130 ft were used with drilled shot holes and 2-oz charges (plus a few air shots in which the same disadvantage was displayed). No serious operational difficulties were encountered, although obtaining uniform amplitudes on each trace is less simple, because the travel distance for the first and last geophone positions is not as nearly identical as it is in conventional deep reflection work. Charge sizes are substantially smaller, and in some instances, with the automatic volume control and presuppression removed, a single blasting cap sufficed. The frequencies of recorded reflections averaged about 125 cy/sec.

Many of the limitations and ambiguities encountered in refraction work are absent in shallow-reflection mapping. The common refraction bugaboo of velocity inversion (the inability to detect low-velocity layers under high-velocity layers) is absent in the reflection method. Shallow-reflection work is much less expensive than core drilling, although some drilling for velocity and geologic control will always be necessary.

The shallow-reflection seismograph is expected to find wide application in ground-water and engineering investigations, mining investigations where stratigraphic and structural control of ore deposition is important, and in solving some of the near-surface problems in oil exploration. Both overburden-thickness problems and shallow structural problems in wide variety may be successfully solved by this new method.

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Received April 27, 1954.