SHORT COMMUNICATIONS

Minerals of rhenium

RHENIUM is an extremely rare element and a magnitude of $c.5 \times 10^{-4}$ ppm for its abundance in igneous rocks has been assessed recently (Morris and Short, 1965). It may be classed as a dispersed element in the sense of Vernadsky (1924), i.e. it occurs primarily in minerals of other elements. Only in recent years has evidence appeared for the existence of minerals with rhenium as a major constituent and, as most of the details have been published in languages other than English, it is felt that a brief report may be of interest.

Rhenium shows a close geochemical coherence with molybdenum and is found in molybdenites of various genetic types in amounts varying from traces up to the value of 1·88 % found in deposits in Armenia SSR (Magak'yan *et al.*, 1963). This is not unexpected, since the ionic radii of Re^{4+} (0·74 Å) and Mo^{4+} (0·70 Å) are alike and ReS_2 and MoS_2 have similar crystal structures and dimensions (Jellinek, 1963). However, although it has been shown that rhenium is carried by molybdenite isomorphously (Kagle, 1960; Faramazyan and Khurshudyan, 1963; Ponomareva and Lebedev, 1962), there have been cases reported where the rhenium content of sulphide ores has exceeded the molybdenum content. Evidence for actual minerals of rhenium is summarized briefly below.

ReS_2? In a study of the mineralization of the copper shales of Mansfeld, E. Germany, Schüller (1959) put forward the suggestion that rhenium disulphide actually occurs as such in the deposits. The rhenium sulphide appears to form the inner parts of spherical particles of molybdenite and differs from the latter in its greater hardness, weak anisotropy, and yellow hue. The mineral has not been properly investigated owing to the difficulty of separating the pure material. Knitzschke (1961) has indicated that the Re : Mo ratios in the Mansfeld and Sangerhausen troughs are unusually high.

Dzhezkazganite. A new type of rhenium accumulation has been found in the cupriferous sandstones of the Dzhezkazgan deposit of Kazakhstan SSR. From a detailed mineralographic and chemical study of the dispersed ores, extremely fine aggregates of a new mineral, dzhezkazganite, were discovered in the sulphidic conglomerations, and less frequently in the dispersed sulphidic disseminations, in close contact with bornite,

chalcocite, and galena (Poplavko *et al.*, 1962; Poplavko, 1962; Satpaeva *et al.*, 1962). According to Poplavko, the new mineral, which occurs in the form of very thin platelets (rarely $> 0{\cdot}1$ mm), contains Re 40–50 % and Cu 15–20 %. The properties of dzhezkazganite suggest that it is a sulphide and the formula $CuReS_4$ has been proposed. Although Poplavko (1962) has pointed out that the molybdenum content did not exceed the rhenium content in any adjacent sulphide mineral studied, Dedeshko *et al.* (1964) have suggested from the results of chemical treatment that the rhenium mineral is probably a rhenium molybdenum sulphide (Re:Mo $\sim$ 1) in which copper is not a major component.

Mineral from Kipushi. Capitant *et al.* (1963) have studied the distribution of rhenium by means of an electron microanalyser in a sample of mineral-complex from the Prince Leopold Mines, Kipushi, Katanga, Congo. The major minerals in the sample were molybdenite, tennantite, and bornite, in that order of abundance, with accessory minerals including chalcocite, covelline, pyrite, and blende. Distribution of rhenium through the molybdenite was found to be variable and the existence of local concentrations indicated the presence of a specific rhenium mineral. The species was located as some small areas on a grey-brown mineral found adjacent to molybdenite in contact with covelline. The inclusions were too small for more than a semiquantitative analysis by the microprobe but contained 'several tens of per cent of rhenium'.

Re_2O_7? Petersen *et al.* (1959) have found up to 0·07 % of rhenium in samples of sedimentary rocks of Triassic age from the Sun Valley uranium mine in N. Arizona, U.S.A., by semiquantitative spectrographic analysis. The rhenium is associated with uranium and molybdenum, and quite convincing evidence has been obtained from leaching and chemical experiments that the element is present in the form of the water-soluble oxide Re_2O_7.

Department of Chemistry,
Brunel College,
London, W.3.

D. F. C. Morris
E. L. Short

References

Capitant (M.), Francotte (J.), Picot (P.), and Troly (G.), 1963. Compt. rend. Acad. Sci. Paris, vol. 257, p. 316.

[Dedeshko (M. P.), Satpaeva (T. A.), and Fain (E. E.)] Дедешко (М. П.), Сатпаева (Т. А.) и Файн (Е. Е.), 1964. Вестн. Акад. наук Казакск. ССР (Bull. Acad. Sci. Kazakh SSR), vol. 20, p. 47.

[Faramazyan (A. S.) and Khurshudyan (E. Kh.)] Фарамазян (А. С.) и Хуршудян (Е. Х.), 1963. Докл. Акад. наук Армен. ССР (Compt. rend. Acad. Sci. RSS Armen.), vol. 37, p. 211.

JELLINEK (F.), 1963. Arkiv Kemi, vol. 20, p. 447.
KAGLE (—), quoted by E. E. Malouf and S. R. Zimmerley in Rhenium (Amsterdam, Elsevier), 1962, p. 3.
KNITZSCHKE (G.), 1961. Zeitschr. angew. Geol., vol. 7, p. 349.
[MAGAKYAN (I. G.), PIDZHYAN (G. O.), and FARAMAZYAN (A. S.)] Магакьян (И. Г.), Пиджян (Г. О.) и Фарамазян (А. С.), 1963. Докл. Акад. наук Армен. ССР (Compt. rend. Acad. Sci. RSS Armen.), vol. 37, p. 77.
MORRIS (D. F. C.) and SHORT (E. L.), 1965. 75-Rhenium, in Handbook of Geochemistry (Heidelberg, Springer), in press.
PETERSEN (R. G.), HAMILTON (J. C.), and MYERS (A. T.), 1959. Econ. Geol., vol. 54, p. 254.
[PONOMAREVA (E. I.) and LEBEDEV (K. B.)] Пономарева (Е. И.) и Лебедев (К. Б.), 1962. Труды Инст. металлург. обогащ., Акад. наук Казакск. ССР (Trans. Inst. Metallurg. and Concentration, Acad. Sci. Kazakh SSR), vol. 4, p. 28.
[POPLAVKO (E. M.)] Поплавко (Е. М.), 1964. Рений, Акад. наук СССР, Инст. мет. Труды 2-го Всес. совещ. (Rhenium, Trans. 2nd All-Union Conf., Inst. Metallurg., Acad. Sci. USSR, 1962), Moscow, p. 19.
[——, MARCHUKOVA (I. D.), and ZAK (S. Sh.)] ——, Марчукова (И. Д.) и Зак (С. Ш.), 1962. Докл. Акад. наук СССР (Compt. rend. Acad. Sci. URSS), vol. 146, p. 433.
[SATPAEVA (T. A.), KALININ (S. K.), and MARZUVANOV (V. L.)] Сатпаева (Т. А.), Калинин (С. К.) и Марзуванов (В. Л.), 1962. Вестн. Акад. наук Казакск. ССР (Bull. Acad. Sci. Kazakh SSR), vol. 18, p. 58.
SCHÜLLER (A.), 1959. Abh. Deutsch. Akad. Wiss. Berlin, Kl. Chem., Geol., Biol., no. 6 (for 1958).
VERNADSKY (V. I.), 1924. La Géochemie (Paris.)

[*Manuscript received 29 November 1965.*]

Note on the crystallization of merwinite from glass of åkermanite composition

THE crystallization of a glass of åkermanite composition was studied by high-temperature microscopy combined with high-speed differential thermal analysis, as described by Mercer, Miller, and Sommer[1,2,3].

The sample was contained in the loop of a thermocouple microfurnace mounted in a water-cooled air-tight cell on the stage of a stereo microscope. A second thermocouple was used as a reference couple and the heat capacities of the two thermocouples were balanced by having a slightly larger junction on the reference couple. The Pt-Rh(5 %)–Pt-Rh(20 %) thermocouples used have a maximum operating temperature of approximately 1700° C. A twin-channel high-speed potentiometer recorder with

[1] Mercer (R. A.) and Miller (R. P.), 1963. Journ. Sci. Instr., vol. 40, p. 352.
[2] Sommer (G.) and Miller (R. P.), 1964. Govt. Metallurg. Lab., Project 46/44, Rept. no. 1, Johannesburg.
[3] Sommer (G.), 1965. Instr. Techn. South Africa, vol. 2, no. 2, pp. 7–16.