

**A note on the sulphur isotope composition of  
chalcopyrite and pyrrhotite from  
the Moskogaissa mines, Birtavarre, Troms**

BY  
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During a visit to Oslo in the summer of 1956, Professor A. M. Bateman of Yale University kindly offered to undertake a determination of the stable isotope ratios of sulphur ( $S^{32}/S^{34}$ ) in specimens of ore from the Birtavarre district of Troms, which the present writer was then studying. It was hoped that the sulphur isotope ratios would assist in arriving at a conclusion regarding the origin of the ores. (See Bateman and Jensen, 1956, and the bibliography therein).

Consequently, two specimens, one of chalcopyrite and one of pyrrhotite, separated from the ore of the old Moskogaissa 117 mine in the Birtavarre district, were sent to Professor Bateman's laboratory for analysis.

Unfortunately, the results did not arrive in time to be included in the publication giving the results of the Birtavarre work (Vokes, 1957). The present note is intended to rectify the omission.

*Results of analysis.* The two sulphide specimens were analysed in the manner described by Bateman and Jensen, using as a standard the  $S^{32}/S^{34}$  ratio of 22.21 for the sulphur in the troilite of Canyon Diablo meteorite.

For the chalcopyrite the  $S^{32}/S^{34}$  ratio obtained was 22.21 and for the pyrrhotite the ratio was 22.25.

If one compares these values with the diagram given as Fig. 1 in Bateman and Jensen's paper, it can be seen that they fall within any

of the ranges given as characteristic for sulphides of sedimentary, hydrothermal, or magmatic origin.

Thus the analysis results must be said to be inconclusive as regards the origin of the sulphides at the Moskogaissa mine or in the Birtavarre district as a whole. The only thing definite that can be said is that the results in no way invalidate the conclusions reached by the present writer on the origin of the ores in his publication.

*Variations in the isotope ratios.* The chalcopyrite and pyrrhotite analysed were separated from a single sample of ore taken from the Moskogaissa 117 mine. The  $S^{32}/S^{34}$  ratios for the two sulphides are very close to each other, varying by a matter of only about 0.2 %. Jensen (1957) has stated that variations exceeding 4 % can occur in the ratios for sulphides coming even from the same hand specimen. Jensen determined the sulphur isotope ratios in specimens of sulphides showing varying paragenetical relationships. He concludes that his studies bear out the assumption that there is a greater probability of variations in the  $S^{32}/S^{34}$  ratios in specimens which show a non-contemporaneous paragenesis than in those which show a simultaneous one. This is because the greater the difference in time of origin of adjacent minerals, the more probable it is that they will differ in isotopic composition.

The present writer's study of the paragenesis of the Birtavarre ores showed that chalcopyrite and pyrrhotite crystallised simultaneously, or nearly so. The small value for the variation between the  $S^{32}/S^{34}$  ratios for the two minerals seems therefore to be in accordance with the abovementioned assumption and with Jensen's conclusions.

### Sammendrag

#### *Svovelisotop-forholdet i kopperkis og i magnetkis fra Moskogaissa-gruvene, Birtavarre.*

Under et besøk i Oslo sommeren 1956 var prof. A. M. Bateman (Yale Univ., U.S.A.) så vennlig å tilby å gjøre en bestemmelse av det stabile svovelisotop-forhold ( $S^{32}/S^{34}$ ) i prøver fra Birtavarre. Håpet var at en slik bestemmelse kanskje kunne være til hjelp under forsøket på å komme til en konklusjon m. h. til opprinnelsen av malmene.

Analyse av kopperkis og av magnetkis i prof. Batemans laboratorium ga som resultat for  $S^{32}/S^{34}$  henholdsvis 22.21 og 22.25. Disse forhold ligger innenfor et område som ansees for felles for sulfider av sedimentær, hydrotermal og magmatisk opprinnelse.

Analyseresultatene gir således ikke anledning til å trekke noen konklusjon med hensyn til opprinnelsen av sulfidene i Birtavarreområdet. Det eneste som kan sies er at de ikke på noen måte står i motsetning til konklusjoner som forfatteren på annet grunnlag har trukket vedrørende malmenes opprinnelse.

### Bibliography

- Bateman, Alan M. and Jensen, M. L.* 1956. Notes on the origin of the Rhodesian copper deposits: isotope composition of the sulfides. *Econ. Geol.* 51, 555—564.
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