

# Komatiite-Related Ore Deposits

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# Conference Reports



## Komatiite-Related Ore Deposits

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A conference on komatiites was held from August 19 to 23, 1979, at Val d'Or, Quebec. The conference was jointly sponsored by the Geological Society of America (Penrose Conference section), the Geological Association of Canada (H. S. Robinson Bequest), National Science and Engineering Research Council, Canadian Geological Foundation, and the Universities of Saskatchewan and Montreal. The convenors were Nicholas T. Arndt and Christopher Brooks. Fifty-two participants with diverse backgrounds in field geology, geochemistry, petrology and ore deposits gathered to integrate their observations and data on komatiites, and to exchange the most recent ideas in their respective disciplines. The conference was especially timely because of the rapid accumulation of information from widely dispersed areas and because the topic is undoubtedly the most exciting recent discovery in the field of petrology, namely that of ultramafic field lava flows.

The conference opened with a one day field trip to the now classic komatiite outcrops in Munro Township, Ontario. This was followed by 3½ days of meetings broken in the middle by a ½-day field trip to the remarkably well-exposed komatiite lavas and tuffs at Lamotte, Quebec. The

former excursion was led by N. T. Arndt and L. Jensen, the latter by L. Gelinas. The sessions had an informal format with few prepared talks and much discussion. From the beginning, the interaction was lively and stimulated the addition of two unscheduled evening sessions.

The conference opened with a historical perspective - an account of the initial recognition and classification of komatiites by Morris and Richard Viljoen. Then followed sessions on the following subjects: the geological environment, petrology and geochemistry of komatiites from various areas; the definition and diagnostic features of komatiite; morphological and textural aspects; geochemistry; tectonic environment; and the relationships between ore deposits and komatiites. An account of the general proceedings is given by Arndt and Brooks (1980) and in this report only the sessions on ore deposits, sponsored by the H. S. Robinson Bequest (GAC), will be discussed.

There were two sessions, each chaired by Morris Viljoen (Johannesburg Consolidated Investment, South Africa). The first dealt mainly with volcanogenic nickel sulphide deposits, and opened with an account by Ray Binns (C.S.I.R.O., Australia) of the principal features of this type of deposit, and a description of some Australian examples, including Kambalda, Perseverance, and the more recently discovered Forrestania deposits. Morris Viljoen described deposits in Rhodesia, and Roger Eckstrand (Geological Survey of Canada) discussed the relationship between metal ratios in the deposits and the host rock compositions. Reid Keays (University of Melbourne) presented new data on platinum group metal concentrations in ultramafic nodules, komatiite lava flows and sulphide deposits, and demonstrated that fractionation of these elements provide a valuable insight into processes that produce the lavas and their ore deposits. The final talk was given by Mike Fleet (University of Western Ontario) who presented experimental data on the partitioning of Ni between silicate and sulphide liquids which he felt cast doubt

on the magmatic theories of origin of some nickel-copper sulphide deposits.

The material presented on nickel deposits was sufficient to occupy the entire period that had been set aside for ore deposits, necessitating the addition of the second unscheduled session. This session (held on the last evening of the conference while some of the more frivolous delegates sampled the rather dubious attractions of Val d'Or nightspots), dealt with possible relationships between komatiites and deposits of gold, antimony and other metals. It turned out to be even more informative and stimulating than the first session. Morris Viljoen described gold mineralization spatially associated with carbonatized ultramafic rocks in South Africa and Rhodesia, and proposed that the gold was introduced in komatiite lavas and released and reconcentrated during carbonate alteration events. This model was supported and expanded by later speakers. Dale Pyke (Ontario Geological Survey, OGS) described the deposits in the Timmins area, and Larry Jensen (OGS) gave a detailed description of the geological environment of gold deposits in the Kirkland Lake-Larder Lake area, Ontario. He then developed a more complicated picture involving leaching of gold during interaction between sea water and hot komatiitic lavas, fixing of the leached gold by organic material in sediments, and finally remobilization of the gold during subsequent carbonatization of the lavas and sediments. These ideas received further support by Reid Keays who described Au and PGM concentrations in the lavas and interflow sediments at Kambalda, Western Australia.

Finally, Trevor Pearton (University of Witwatersrand) described antimony-gold mineralization in the Murchison greenstone belt, South Africa, which, he suggested, may have resulted from the migration of these elements during the carbonate alteration of extrusive or intrusive ultramafic rocks, or of Mg-rich, pelitic sediments of possible detrital komatiitic origin. The session therefore

became a forum for the discussion of a previously little recognized type of mineralization, and provided an opportunity for communication and exchange of ideas between specialists working on deposits in three continents.

Following the conference, a number of participants were led by Jensen and Pyke on tours of the gold deposits and general geology along the Larder Lake Break in Quebec and Ontario.

#### Acknowledgements

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#### Reference

Arndt, N. T., and Brooks, C., 1980. Penrose Conference on Komatiites: *Geology*, in press.

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## Gold Workshop, Yellowknife

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Increasing interest in gold, as the price neared \$500 an ounce, was reflected by the 120 geologists who assembled in Yellowknife to participate in a gold workshop on December 3-5, 1979.

The meeting began Monday evening with an orientation session for those taking part in Tuesday and Wednesday morning trips to Giant Mines underground and open pit operations and to the Con Mine. Technical sessions were held on Tuesday and Wednesday afternoons with talks on the Economics of Gold on Tuesday evening. The workshop concluded on Wednesday evening with a memorable discourse on the early history of the Yellowknife Gold Camp by Dr. A. W. (Fred) Jolliffe, Professor Emeritus of Queens University. He amused, entertained and impressed some 250 people who attended a special meeting of the Charles Camsell Geological Society.

Jolliffe recounted the history of the first geological mapping of the north shore of Great Slave Lake in 1935. This work led directly to the discovery of gold in volcanics at Yellowknife when prospectors Vic Stevens, Don McLaren and Ed (Red Eye) McLellan accompanied geologist Novan Jennejohn, one of Jolliffe's assistants, on his last traverse of the year across part of the Kam basalts, considered favourable for minerals because they were intruded by a small granodiorite stock. Just north of the stock Jennejohn knocked a piece of quartz from an outcropping vein, found gold and with the aid of a federal government axe, staking began.

Referring to the most recent ideas on gold transport and deposition and the genesis of gold deposits in general as elaborated during the technical sessions, Jolliffe commented: "Clearly we gave them incorrect advice (to look for gold

near a stock) but they found gold and that got the Yellowknife camp started."

#### Yellowknife Mines - Field Trips

Padgham (DIAND) began Monday night with an overview of the geology of the dominantly basaltic, epidote-amphibolite facies Yellowknife Volcanic Belt. The geology of Yellowknife mines was discussed by Dave McMurdo (Con) and Wilf Meyer (Giant).

Both mines are in complex quartz carbonate sericite shear zones. Usually there is more than one subparallel ore zone on any cross section. On the east side of West Bay Fault, ore zones at Giant have been mined (discontinuously) over a length of nearly 6 kilometres but they have a limited vertical extent (500 m). Meyer noted the apparently folded nature of the Giant shear system within the 'unfolded', now near vertical, volcanic pile. Con orebodies on the west side of the Fault have much less horizontal extent than Giant's, about 1,500 m, but greater vertical extent. Ore has been found to below 1,600 m. No orebody in either mine extends the whole length or depth of the mined zones.

Meyer noted that though the Campbell shear zone was found by reconstructing offset on the late Proterozoic West Bay Fault, the orientation of the orebodies, their mineralogy and the differences in horizontal and vertical extent of ore zones makes direct correlation uncertain. He also contended that the sub-Jackson Lake unconformity is responsible for the marked thinning of the Kam Formation to the north and that the auriferous shear zones do not penetrate the unconformity into the overlying formations. Thus the unconformity has genetic significance for Yellowknife gold deposits. Not all who have worked in the area accepted this but most agreed that the shear zones appear to be spatially related to the volcanic/intrusive contact to the west.

The Con and Giant Mines have produced 5.9 million tons (3.5 m ounces) for an average grade of 0.6 ounce/ton and 10.2 million tons (6.34 m ounces) for an average grade of 0.62 ounce/ton respectively. This 9.84 million ounces represents 88% of the 11.2 million ounces of gold produced by all N.W.T. mines. Cut-off grades have been lowered with improved access and ore handling following the commission of the 6,000 foot deep Robertson shaft at the Con Mine and especially with open pit mining at the Giant Mines. Grades as low as 0.2 ounce/ton can be profitably mined from relatively small open pits which now provide approximately 30% of the Giant production.

#### Economics of Gold and of Gold Mining

Paul Kavanagh introduced the Tuesday