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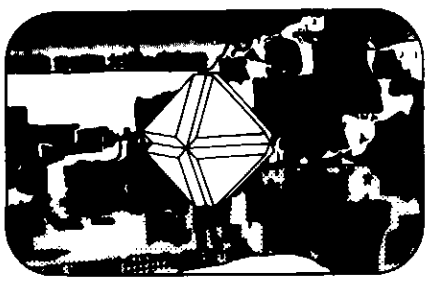

Second International Kimberlite Conference

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Introduction

The Second International Kimberlite Conference was held at Bishops Lodge, Santa Fe, October 3-7, 1977. Over 200 delgates attended the technical sessions at which 113 papers were presented. Many of the papers presented the results of investigations of material collected during the First International Kimberlite Conference in South Africa and Lesotho. The contributions of the conference to some specific areas of research are reviewed below.

Diamonds

Studies of the silicate inclusions in diamonds did not reveal any unusual new mineral assemblages and merely confirmed that two distinct mineral suites are present as inclusions, i.e., the "lherzolitic" and "eclogitic" suites. Tsai (Purdue) reported that sulphides are relatively rare in diamonds and that the black material commonly considered to be sulphide is in fact graphite. Sulphides are present as complex intergrowths of pyrrhotite-pentlandite-chalcopyrite and nickeliferous pentlandite-magnetite. Harriss (Edinburgh) reported the results of a study of the morphology and colour of several thousand Southern African diamonds and showed that each pipe has a characteristic diamond assemblage and that this may be in part due to diamond dissolution rather than growth. McCallum (Colorado State) presented the first comprehensive description of diamonds from the Colorado-Wyoming kimberlites. Although some discussion of the stability and growth of diamond and graphite took place this conference did not result in any major steps forward in theories of diamond genesis. Many questions remain unanswered, for example, what is the origin of the two suites of inclusions in diamond and why are inclusions of the discrete nodules suite absent. The absence of this latter suite remains an embarassment for those would grow diamonds in kimberlite magmas. The eclogite suite could be derived by fragmentation of diamond-eclogite but this merely begs the question as no theories are forthcoming to explain the growth of diamond in eclogite (are they phenocrysts? porphyroblasts?). The lherzolite suite presents problems in that no garnets equivalent in composition to those of the inclusions are known in garnet lherzolite xenoliths. Rosenhauer (Frankfurt) and Woermann (Aachen) presented important papers on the role of volatiles in diamond and graphite stability and noted that the role of mantle carbonate breakdown in diamond genesis be examined.

Eclogites

The origin of eclogite continues to provoke stimulating discussion, as depending upon one's particular viewpoint they can be considered to be either mantle cumulates or subducted crustal material. Hatton and Gurney (Cape Town) presented evidence that the Roberts Victor eclogites are cumulates of complex origin, not related to the kimberlite in which they occur and are unlikely to be the result of differentiation of a single body of magma. This viewpoint was supported by Kramers' (Witwatersrand) evidence that the eclogites are very much older (2700 my) than the kimberlite (127 my). In contrast Smyth (Los Alamos) proposed that some of the coesite-bearing eclogites at Roberts Victor are subducted crustal cumulates. Helmstaedt and Schulze (Queens) presented further evidence to support the hypothesis that the eclogites found in the Colorado Plateau diatremes are subducted Franciscan eclogites and moreover they proposed that some of the uplift of the Colorado Plateau can be ascribed to hydration of underplated meta-ophiolites. Diamond and graphite-bearing eclogites were described from a number of Southern African kimberlites and Robinson (Anglo Amer., RSA) noted that such eclogites are enriched in diamonds by a factor of 1000-10000 over kimberlites and proposed that the entire diamond content of some kimberlites could be produced by disruption of diamond-eclogite.

Lherzolite Zenoliths in Kimberlite

Studies of mantle derived lherzolite xenoliths in kimberlite did not create as much controversy as at the First Kimberlite Conference. The present conference was disappointing in that over the past four years the problems of interpreting the PT equilibration data have not been resolved. The conference did not come to grips with the "paleogeotherm problem" and no review papers were presented which might have clarified the present status of the problem for those

not involved in xenolith research. Questions which remain unanswered are, for example, do the PT data represent mantle equilibration pressures and temperatures or simply the heating effects of kimberlite magma? and why in a small area of Lesotho can one determine a perturbed geotherm (Thaba Putsoa-Mothae, Kao), no geotherm (Matsoku) or a normal geotherm (Pipe 200)? Participants agreed that the problem lies in unresolved ambiguities in the basic expermental data, especially the solubility of alumina in pyroxenes, and in methods of data interpretation in an effort to correct for the presence of minor elements and iron in natural minerals. No consensus was reached as to whether one set of experimental work or correction method was preferable to any other, and each group of petrologists uses its own favourite method, making intercomparisons of results difficult. This problem might be resolved by establishing a data bank of mineral analyses from lherzolites and a common method of data interpretation. The conference particularly demonstrated the need for high pressure and temperature studies of natural garnet lherzolites.

Studies of the accessory and secondary minerals in xenoliths are increasing in number and are indicating that xenoliths are commonly subjected to "metasomatism" both within the mantle and during their transport within kimberlite. Penetration of fluids rich in iron, titanium, phosphorus and potassium results in the formation of such minerals as potassic richterite (Ehrlank, Cape Town) and potassic sulphides (Clarke, Dalhousie). Recognition of metasomatic events involving alkali and alkaline earth elements is extremely important for those who undertake whole rock geochronological and geochemical studies of lherzolites.

A third trend in xenolith research is towards electron microscope studies of dislocations (Nicolas, Nantes) and exsolutions microstructures (McCallister, Purdue) in xenolith minerals in an effort to determine the strain rates and annealing characteristics of the mantle or the thermal history of xenoliths during the transport in kimberlite. These studies hold much promise in interpreting PT equilibration data and in determining the velocities of kimberlite intrusion.

Kimberlites

General description of several kimberlites in the U.S.A., Southern Africa and India were presented. Of particular significance were the compilations of the occurrences of kimberlite and pseudokimberlites in Australia (Stracke, Stockdale Prospecting, Melbourne) and Brazil (Svisero, Sao Paulo). Notably lacking were descriptions of Russian occurrences. McGetchin (Lunar Sci. Instit.) presented the interesting hypothesis that ferrokimberlitic volcanism may have been a major process on Mars.

Detailed mineralogical studies of kimberlites remain few in number. Comprehensive data for oxide and sulphide minerals was presented only for the Green Mountain (Boctor and Meyer, Purdue) and Tunraq kimberlites (Mitchell, Lakehead). The mineralogical studies, ably summarized by Haggerty (Amherst) continue to demonstrate that kimberlite evolved under unusually low oxygen fugacities. Raber and Haggerty (Amherst) presented an important study of zirconium oxides and reported the first occurrence of zirconolite in kimberlite. Pasteris (Yale), with her detailed examination of surface morphology by electron microscopy, brought a new approach to the study of ilmenite megacrysts. The origin of the rounded olivine megacrysts so characteristic of kimberlite remains enigmatic, Boyd (Geophys. Lab.) presented evidence that several populations of both xenocrysts and phenocrysts might be present in the De Beers kimberlite.

Experimental studies relevant to kimberlite genesis were presented by Wyllie (Chicago), Eggler (Penn. State) and Brey (Hannover). All the experimentalists agree that mantle carbonates play a role in the generation of CO_2-rich partial melts but seem unable to agree as yet on the exact composition of the liquids formed. Significantly all the experimental work relevant to kimberlite is carried out at high pressures and temperatures, no experimental work at low pressures simulating the post-fluidization crystallization history of kimberlite appears to be being conducted or contemplated.

Relatively few papers were concerned with the geochemistry of kimberlite. General works were present by Frey (MIT), Scott (Anglo Amer., RSA) and Wedepohl (Gottingen). The first accurate data for platinum metals were presented by Crocket (McMaster) and a useful summary of the uranium geochemistry of kimberlite by Brookins (New Mexico). The geochemical work presented at this conference did not result in any significant advances in understanding the evolution and genesis of kimberlite.

Kobelski (Exxon Co.) presented a major work on the carbon and oxygen isotope geochemistry of kimberlite which indicated that individual kimberlites have distinctly different isotopic compositions and that meteoric water was involved in the fluidized system.

Basalts and Basements

Two sessions of the conference dealt with matters not directly related to kimberlite, specifically xenoliths in basalts and the composition of the lower crust. The former provided some useful comparisons between spinel lherzolites found in basalts and kimberlites and the latter provided much information on lower crustal granulites and their partial fusion on incorporation in basic magmas. Data presented by Griffin (Oslo) and Carswell (Sheffield) has now provided a complete stratigraphic section from lower crust to upper mantle beneath North Lesotho.

Summary

In all, this conference left a lot of important questions unanswered; hopefully they will be addressed should a Third Kimberlite Conference be held. The proceedings of the Conference and the Field guides to the State-Line kimberlites, the Colorado Plateau diatremes and Southwestern USA xenolith occurrences will be an invaluable addition to the literature on kimberlites and upper mantle materials.

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