TRAINING IN DIAMOND EXPLORATION
Course held at Bangalore from 10th to 22nd January 2008

Course organised by the Geological Society of India and sponsored by the Geological Survey of India, the National Geophysical Research Institute, the National Mineral Development Corporation, Mineral Sales Private Limited, the Rio Tinto India Ltd. and the Department of Science and Technology.

Introduction

Geological Society of India organized a Group Discussion on “Kimberlites and Related Rocks of India” between 22nd and 26th November 2005 which was followed by the publication of a Special Issue of the Journal (Vol. 69, No.3) on the subject in March 2007.

Dr. B.P. Radhakrishna having reflected on the level of expertise in the Indian Geosciences Community regarding the identification and characterization of diamond-bearing rocks, limited exposure to diamond-bearing rocks from other parts of the world, lack of knowledge of techniques of exploration and evaluation of potential diamond deposits, the non availability of equipment such as rotary-pan plants, poly-tungstate heavy media separation units, lack of knowledge on fusion studies, non availability of field oriented mobile beneficiation plants for recovery of diamonds, lack of practical knowledge in converting explored prospects into mineable deposits; suggested organization of two short courses to be conducted by experts in the subject. At the request of the Geological Society of India, Prof. R.H. Mitchell and Dr. Howard Coopersmith came over to Bangalore and conducted an intensive course.

Course Leaders

Prof. Roger H. Mitchell is one of the world authorities on the petrology of kimberlite and related rocks. He has to his credit three monographs devoted to mineralogy, geochemistry, and petrogenesis of these rocks. His another monograph “Kimberlites, Orangeites, Lamproites, Melilites and Minettes: A Petrographic Atlas” with 400 original colour photomicrographs and back scattered false colour images depicting the characteristic textures and mineral assemblages found in the above rocks is serving as invaluable reference work for academic and exploration geologists concerned with the identification and description of the petrology of diamond-bearing rocks. Prof. Mitchell is honorary fellow of several professional associations including the Geological Society of India.

Dr. Howard G. Coopersmith, geologist and diamond consultant has extensive experience in diamond exploration which he acquired by managing Cominco American Inc.’s diamond exploration program for a
Group photograph of the participants attending the training programme.
decade (1975-1985). He prospected a diamond-bearing area on the Colorado-Wyoming border called the State Line region. Despite his modesty, Dr. Coopersmith's achievement has put the United States on the map as a diamond producer. Dr. Coopersmith was head of several diamond exploration companies and is currently head of Coopersmith and Associates, a Consultant unit in Economic Geology in Fort Collins, Colorado.

Participants in the Course

The following 23 Geologists were selected based on their experience in diamond exploration to participate in the training program.

National Geophysical Research Institute: A.P. Singh, G. Vidyasagar, D. Mysaiah, M. Sathyanarayanan, T. Yellappa
Mineral Sales Private Limited: V.V.N. Raju, A. Chandrashekar, N.K. Vinoda, Niranjan Sahoo, Tushar Sainger
Rio Tinto India Ltd., Bangalore: Prabir Sengupta, Ashish Vaidya, Indresh Rathore
National Mineral Development Corporation Limited: CH. Sravan Kumar, R.K. Garg, Dr. Abhijeet Mukherjee
Punjab University, Chandigarh: Gurmeet Kaur
Department of Mines and Geology, Karnataka: C.V. Raman

Inauguration

The training program was inaugurated on 10th January 2008 at Sampat Iyengar Hall, Geological Survey of India, Bangalore by N.K. Dutta (DDG and Head, AMSE, GSI), A.K. Chattopadhyay, M.M. Swamy, Biplob Chatterjee, R.H. Sawkar and S.V. Srikantia addressed the trainees on aspects of Indian diamond production, mineralogy genetic classification of diamond-bearing alkaline ultramafic rocks, diamond exploration activities, kimberlites discovered, future prospects, similarity of geological and tectonic set up of the Dharwar cratonic region with those of South Africa and other Gondwana segments where diamond production was significantly high. A film "Search for Diamonds" produced by the Geological Survey of India was screened during the inaugural function.

Training Programme

The training course was organized in three parts. The first part represented the Introductory Course held during first three days of the programme and covered the Indian examples by the resource persons from Indian professional organizations, universities and institutes. The second part represented the Main Course conducted by R.H. Mitchell and Howard Coopersmith for six days from 14th to 19th January 2008. The third part involved fieldwork in Wajrakarur Kimberlite area and a concluding session at Guntakal.
Inaugural function of the training course at Prof. Sampat Iyengar Hall, Vasudha Bhavan, Bangalore. Dignitaries on the dias (from left to right) Shri M.M. Swamy, Shri A.K. Chattopadhyay, Shri S.V. Srikanta, Shri N.K. Dutta, Shri Biplob Chatterjee and Shri R.H. Sawkar.

Introductory Course

The subjects covered during the Introductory Course from 10th to 12th January 2008 were:

- Historical Development of Diamond Mining in India by S.V. Sathyanarayana.
- Petrology of Kimberlites, Lamproites and Lamprophyres by Fareeduddin.
- Contribution of Kimberlites and Lamproites in Understanding the Nature and Evolution of Subcontinental Lithospheric Mantle; and Petrology, Geochemistry and Genesis of Alkaline Mafic Potassic Ultrapotassic Rocks from India: Three Case Studies from Chelima, Jungel and Majhgawan Occurrences by N.V. Chalapathi Rao.
- Stream Sediment Sampling Methods in Kimberlite Exploration and also on Structural Controls and Perspectives in Kimberlite Exploration with Reference to Dharwar Craton, India by T.R.K. Chetty.
- Diamond Exploration in Indian Context by S.V. Sathyanarayana.
- Geochronology and Isotope Geochemistry of some Indian Kimberlites by Anil Kumar.
- Mantle Xenoliths in the Wajrakarur Kimberlites by S.C. Patel.
- Exploration for Diamonds in South India by S.S. Nayak.
- Diamond Exploration – form Regional Area Selection to Prospect Scale Exploration – Some Illustrations by Biplob Chatterjee.
- Diamond Exploration by NMDC in Kalyandurga Area by Abhijet Mukherjee.
- Geophysical Studies in Search of Kimberlites and Related Rocks – Case studies from South India by M. Kesavamani.

Main Training Course

The main Training Course covered by Dr. R.H. Mitchell and Dr. Howard Coopersmith was spread over six days. Course started each day at 8 a.m. and ended at 6 pm with an interval of one hour in the middle.

1st Day

In the morning session Prof. Mitchell covered the following aspects: Mineralogical-genetic classifications of alkaline rocks. Nomenclature and mineralogical characteristics of: kimberlites; lamproites and other rocks.
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(orangeites etc) derived from metasomatized lithospheric mantle, melilitite clan rocks (ailikites, alnoites etc), mmettes and calc-alkaline lamprophyres. Characterization and petrography of diamond-bearing alkaline rocks using optical and electron beam methods. Petrogenesis and some aspects of the geochemistry of alkaline rocks.

In the afternoon session, Dr. Coopersmith covered Types of Diamond deposits (geological types, characteristics, examples, world mine production) and Area Selection (global setting, tectonic setting, structural criteria).

2nd Day

Second day’s lecture covered the following topics: Petrology of Kimberlites Current models of kimberlite emplacement as illustrated by Southern African / Russian diatreme systems, the Fort a la Corne volcanic systems, Lac de Gras type vents by Prof. Mitchell.

In the afternoon session, Dr. Coopersmith covered Exploration Techniques (indicator mineral, geophysical, geochemical, remote sensing, mineral chemistry) and Design of Surveys (scale, methodologies, result interpretation).

3rd Day

Prof. Mitchell lectured on Characterization and recognition of hypabyssal kimberlite, pyroclastic kimberlite, tuffisitic kimberlite; reworked kimberlite in the morning session.

In the afternoon session, Dr. Coopersmith covered Deposit Exploration and Evaluation (drilling, delineation, geological modeling, sampling, micro-diamond samples, bulk sampling).

4th Day

Fourth days’ topic included Petrology of Lamproites Current models of lamproite emplacement as illustrated by West Kimberley, the Leucite Hills, and Arkansas lamproites Characterization and recognition of lamproite and differences with respect to kimberlrite by Prof. Mitchell.

In the afternoon session, Dr. Coopersmith covered Evaluation Results (micro-diamonds, macrodiamonds, diamond valuation, geological models, ore resources and reserves and feasibility studies).

5th Day

Prof. Mitchell lectured on Petrology of melilitite clan rocks and mnettes Characterization and recognition of differences with respect to lamproite and kimberlrite Classification of Indian “lamproites” and other potentially diamondiferous rocks.

In the afternoon session, Dr. Coopersmith covered Diamond Mining and Processing (selection of mining type, process plants, environmental considerations) and Rough Diamond Sorting and Marketing (types of commercial diamonds, diamond sales, branding, Kimberley process).

6th Day

The whole of sixth day was devoted to questions and answers.

One distinguishing feature of the course was that all the participants were given a Compact Disc (CD) containing files of all the Powerpoint presentations and MS Word files of relevant literature and notes.

Field Visits

A field visit to kimberlite pipes of Chigicherla, Lattavaram and Wajrakarur clusters was organized with the help of geologists from the Geological Survey of India. The trainees interacted freely with the faculty members and discussed petrology and petrogenetic aspects of the kimberlites observed in the field and exploration techniques to be adopted in these conditions. A visit to kimberlite park, kimberlite museum and kimberlite processing plant at Wajrakarur was also organized. The Officers of the Geological Survey of India presented core samples of kimberlite pipes to the trainees as mementos.

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Some Opinions Expressed by the Trainees

We extract below some of the appreciative remarks made by the trainees who attended the course.

Participants from the National Geophysical Research Institute (NGRI) expressed that the training programme conducted covered all aspects of geological, geophysical and geochemical methods of kimberlite exploration and evaluation of diamond deposits. Methods suggested in the training programme to relate group of kimberlite on regional scale by mineral chemistry and magnetotelluric methods would greatly help NGRI in taking up studies in DST sponsored diamond projects.

Participants from the Mineral Sales Private Ltd. (MSPL) expressed that they would try some of the new techniques such as the use of X-ray machines and rotary pan concentrators in their current diamond exploration Project.

Representatives of the National Mineral Development Corporation (NMDC) mentioned that field oriented mobile beneficiation plants and testing of bulk samples in laboratory for fusion studies were of interest to them and they would try to implement these in their programs.

Exploration geologists of Rio Tinto India Pvt. Ltd., suggested that such training program should become an annual feature and it should be conducted in two modules: (i) A basic course and (ii) An advanced course. This would result in the training of more number of younger geologists to update knowledge in recent developments of diamond exploration. A suggestion was put forward that hand specimens and related thin sections are made available to the trainees.

Trainees from Geological Survey of India (GSI) expressed that they were benefited by the suggestions of the field oriented examination of kimberfite pipes, methods of collection of bulk samples for testing in laboratory and evaluation of prospects.

Representatives on behalf of Universities and Research Institutions expressed that they were able to learn fundamentals and advanced studies on different types of rocks hosting diamond. More important to them was the method of preparation of study of thin sections in understanding texture and model mineralogy. Training program had helped them to teach the techniques to post-doctoral research students in understanding magma types, their petrography and alterations. A suggestion was made that the Society should consider organizing a training program exclusively for university teachers.

Representative of the State Department of Mines and Geology expressed that he was benefited by the training program in identification of the regional set up in exploration of diamond prospects. He suggested that State Department Geologists involved in the grant of RP, PL and ML application should be given a separate site specific training program to understand the workings of companies engaged in exploration of diamond prospects.

Dr. Howard Coopersmith, after returning back home has sent the following mail to Fareeduddin: “I thank you for all your excellent organizing skill for the kimberlite workshop (training). You made everything work well and flow easily. And we enjoyed our tour of your great country.”

Conclusion

R.H. Sawkar summarised the entire programme and called upon the participants to make use of the knowledge gained during the course in their professional career. Prof. R.H. Mitchell hoped that the trainees would utilize the knowledge gained during this course in their professional career. He invited the trainees to contact him for further guidance.

The training programme was successfully completed with the active cooperation of all the faculty members and the participant trainees. The training course was conducted with the logistic and financial support of the Geological Survey of India, the National Mineral Development Corporation, the National Geophysical Research Institute, MSPL, the Rio Tinto India Ltd. and the Department of Science and Technology, New Delhi. We express our grateful thanks to all the above sponsoring agencies.

Course Coordinators
Bangalore

R. H. SAWKAR 
FAREEDUDDIN