

Continental scientific drilling: review of EPB activities 1984-85

**Malcolm Drury
Division of Gravity, Geothermics and Geodynamics
Earth Physics Branch
Energy, Mines and Resources Canada**

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Branch scientists have been involved in discussions relating to scientific continental drilling, a topic of considerable interest in some other countries. This report is a summary of activities since the spring of 1984.

Although some mention of scientific drilling had been made in the various lithoprobe plans and documents, that project is essentially one of seismic reflection and refraction, with the benefit of some geological studies. A committee of lithoprobe to consider the use of methods other than seismics was formed some time ago, but it has met only once. Jessop is nominally a member of that committee.

In the spring of 1984 Jessop and I were made aware of an international workshop on continental scientific drilling, to be held in May 1984 in Tarrytown, New York. We felt that our attendance was important. As I had prior commitments, we decided Jessop should attend. He did so, and reported on the symposium in Gravity, Geothermics and Geodynamics Internal Report 84-6. A broad range of topics was discussed, and much was learned of contemporary international plans for continental drilling.

Subsequently I undertook a project to compile a history of scientific drilling at the Earth Physics Branch and its predecessor, the Dominion Observatory, and to provide and solicit ideas from other Branch scientists on possible renewed drilling activities. The result was a long and detailed report, written in conjunction with Jessop, and released at the end of January 1985 as Gravity, Geothermics and Geodynamics Internal Report 85-3. The report comprised sections on history of drilling, a summary of current activities in other countries, a discussion on the philosophy of drilling, and an extensive list of suggested targets, divided among shallow, intermediate and deep holes.

Shortly after IR 85-3 was released and circulated, Berry contacted W.S. Fyfe and asked him to attend a CANDEL meeting planned for 13th March, to address the question of continental scientific drilling. Judge and Lambert attended that meeting, but I have seen no formal record. However, some notes circulated later indicate that CANDEL wished to hold a workshop on drilling; a brief proposed outline was included, to which both Jessop and I added.

After the report had been circulated, I called a meeting of interested scientists, on 28th February 1985, for further discussions on whether or not a revitalised drilling programme was appropriate, both for EPB and Canada. Berry explained that the CANDEL committee was considering continental drilling, particularly as part of the lithoprobe project; the committee of which Jessop is a member was not mentioned. It was agreed that any future EPB programme of deep drilling must be of a multidisciplinary nature, and must include people from universities and other branches of EMR.

In April Jessop attended a meeting of DOSECC (Deep Observation and Sampling of the Earth's Continental Crust) in Houston. DOSECC is a consortium of universities, and is supported by the U.S. National Science Foundation. Jessop prepared a report on the meeting (Gravity, Geothermics and Geodynamics Internal Report 85-12, May 1985). Also in April, Jessop and I attended a

meeting of the International Crustal Research Drilling Group (ICRDG), in Guelph, at the invitation of Dr. J. Hall of Dalhousie university. I gave a short talk on the history of EPB drilling. Although ICRDG has members from several countries, there was considerable discussion of continental drilling in Canada. The members recognised that the Canadian landmass offers much that is not available in most parts of the world - Archaean cratons, greenstone belts, Proterozoic basins, for example, - and that exciting drilling programmes could be undertaken. The group as a whole did not wish to become involved in any national programme, but several members expressed interest and enthusiasm individually. In particular, after I had raised the possibility of deep drilling in greenstone belts, there was much discussion. ICRDG is primarily interested in unusual oceanic-type crust, such as Iceland and ophiolites, and the problems of greenstone belts are therefore relevant to many of their interests. Individuals also expressed concern about a national drilling programme being too closely tied to other national programmes.

In May, I learned of a deep drilling project being undertaken in Nova Scotia. Two 1.7 km deep holes were planned in the South Mountain batholith. I was invited by the Nova Scotia Department of Mines and Energy to participate, at no cost; an invitation that I accepted enthusiastically. I prepared a formal proposal for geothermal work in the holes, that I subsequently made into another Gravity, Geothermics and Geodynamics Internal Report (85-11), as it could be used as a model proposal for any drilling programme. Plans have changed, and only one hole has been drilled, to 1.4 km. Temperature logging is planned for the near future, as soon as the hole is available. The second hole may be drilled in 1986, and two further holes in 1986 and 1987.

Following these developments, I called a second meeting of interested scientists to bring them up to date. Berry reported on the CANDEL meeting. J. Hall (Dalhousie) had been asked to organise a working group to meet in the summer and prepare, in a general way, an initial proposal for a Canadian programme. No drilling targets were to be identified. Subsequently Branch Management Committee had decide Grieve and Irving should attend.

In July I attended that meeting at the express invitation of Hall, with whom I had previously discussed our ideas at the meeting in Guelph. Present were representatives from the GSC (R. Price, C. Findlay, J. Percival and R. McQueen), from EPB (Drury, Riddihough) and from Dalhousie (Hall, Robinson). The meeting lasted one and a half days, and discussions were wide ranging. It was agreed that too close a tie with existing programmes such as lithoprobe was undesirable; the feeling was that if funding for the major programme were reduced, it would be minor programmes that would be cut out first. A Canadian drilling programme could be developed that was in parallel to lithoprobe, but not necessarily with the same objectives. There was some concern expressed regarding some of the lithoprobe proposals; for example, it was noted that the Abitibi proposal makes no mention of the process of formation of greenstone belts, a question that could, perhaps, be answered by deep drilling. It was noted that the scientific communities concerned with seismic profiling and deep drilling are not the same, although there might be overlap.

The question of a national data base of boreholes was discussed; it was

felt that there is a pressing need for such a file. I described the file that we maintain for our own use, and circulated copies of a report by Jessop giving details of the location, nature etc. of the 18 holes drilled for purely scientific purposes by the EPB geothermics group in the past 23 years (Gravity, Geothermics and Geodynamics Internal Report 85-9).

The main part of the meeting was concerned with scientific possibilities for drilling. Several generic targets were identified, and in some cases specific targets were suggested. The generic ones included:

- greenstone belts - their nature, vertical thickness, formation
- plutons - their thickness, distribution of radiogenic elements, formation
- major thrust zones - Appalachians, Wopmay orogeny, Cape Smith
- craters- enigmatic Sudbury
- Cordillera - e.g., coast range plutons, Anahim belt
- sedimentary basins - Proterozoic to Tertiary
- geothermal systems - including hydrothermal circulation both ancient and modern
- electrical conductivity anomalies - e.g. central plains
- lower crust - Kapuskasing, Pikwitonei

Plans for a general meeting in 1986 were also discussed. I asked Price if a hall at GSC could be used and was told that Camsell Hall would be available. Further, GSC would be able to provide administrative support. It was agreed that those at the July meeting would form an organising committee, and that Hall would take the lead. Price had prepared a tentative schedule for the 1986 meeting; it was modified somewhat during ensuing discussions but largely accepted. It was decided that the meeting should extend over three days; that it should be open to anyone who was interested; that representatives of national drilling programmes from other countries should be invited; and that keynote speakers from Canada should be identified and invited. There was some discussion on who the speakers should be, and a list of names was produced. Themes and names were combined on a tentative basis; both Riddihough and I were careful to ensure that representation from EPB was strong. The plans for the meeting have now progressed to the stage that formal notification has been sent out to the earth science community in Canada; Jessop has been invited to talk about the history of geothermics and I have been asked to give a theme talk on future possibilities for geothermics. I have written to other members of the Canadian geothermics community concerned with continental heat flow soliciting ideas and suggestions so that I can properly represent the discipline. The meeting is to be from 3rd to 5th February.

Early in October a small group of scientists from EPB and GSC met to discuss the choice of speakers for the February meeting. Jessop and Lapointe, who had earlier been nominated by BMC to help organise the meeting, were involved. Some adjustments to the original proposals were made, and were subsequently passed on to Hall by Percival (GSC).

A second small meeting was held recently in Ottawa. It was organised by A. Darnley of the GSC and held in Ottawa. Alan Taylor attended for the EPB, at my suggestion in the July meeting. The meeting addressed the technical questions of drilling and borehole logging, to ascertain the capability of

Canadian industry to meet the depth, coring and geophysical logging requirements. It was attended by several industry representatives, who seemed to support the idea of a national drilling programme. While it was clear some development might be undertaken in drilling and coring technology, it was considered safer to adapt scientific programmes of drilling projects to the current well-known Canadian technology, perhaps importing technology where appropriate. Taylor subsequently prepared a report on the meeting (Gravity, Geothermics and Geodynamics Internal Report 85-21).

On 29th October, at the request of J. Hall, I attended a meeting between some of the planning committee and officials of NSERC; present also from EPB was Berry. The purpose was to introduce NSERC to the concept of a national drilling programme, and to make them aware of what has been going on in the past few months. Hall gave an excellent talk, after which there was general discussion. Berry assured the NSERC people that a drilling programme would not be in competition with lithoprobe. My feeling, from talking to various people from different institutions, is that the question of competition with lithoprobe is unimportant, as it will be at least three or four years before any major national drilling programme can be started, by which time lithoprobe should be reaching its final phase. Furthermore, lithoprobe results might well have led to identification of a target; in any case, target selection would require the information that could only be obtained from substantial work in surface geophysics. The February meeting should provide some indication of how the Canadian geoscience community wishes to proceed.