Dr. Jonner

CONTINENTAL DRILLING IN CANADA:

DRILLING TECHNOLOGY AND BOREHOLE STUDIES

COMMENTS ON A MEETING HELD OCTOBER 23, 1985

Al Taylor

Internal Report 85-21

Gravity, Geothermics and Geodynamics
Earth Physics Branch
Energy, Mines and Resources Canada
1 Observatory Cresent
Ottawa, Ontario K1A 0Y3

November, 1985

A meeting was held in July, 1985 to discuss outstanding geological problems that could best be studied through deep drilling, and specifically that could best be investigated in Canada because of shallowness of target (Drury, 1985). A number of environments were suggested that would imply drilling to depths as great as 10 to 15 km.

The purpose of this October meeting was to review the drilling and coring capability of the Canadian industry to ascertain their ability, and interest, to meet this challenge. As it was recognized that such depths were well beyond the present capability, the industry participants were asked to identify the current major limitations and to assess the feasibility of extending the technology to meet the requirements.

A list of participants is attached; they included several scientists from government, representatives of the diamond drilling industry and the oilfield rig operators. The Canadian Petroleum Association was represented. Mr. John Beswick, the chief engineer involved with the scientific drilling in Cornwall, Great Britain was in attendance.

The meeting followed the published agenda, starting with Matt Salisbury reviewing current scientific continental drilling programs around the world and summarizing the geologic motivation for scientific drilling in Canada, as established at the July meeting.

DRILLING TECHNOLOGY

The current state of drilling technology was discussed at length. The following are some of the principal points of concern to the deep scientific drilling program:

1. The maximum depth attainable by a Canadian (and probably any) diamond drill rig is 4200m (a Heath and Sherwood rig currently on contract in South Africa). Complete core can be recovered to this depth. Bradley Brothers, who are familiar with scientific drilling through their work in Cyprus, Bermuda etc, can reach 3650m with BQ size core (about 6 cm). The limiting factor is strength of the relatively thin-walled drill string and threads, not power.

2. A 3000m hole, completely cored, could probably be drilled in 5 to 6 months and would cost about $700k. A 4200m hole might take a year and cost $2M. Coring represents about 30% of the cost.

3. Oilfield drilling capability in Canada is about 10km; in North America about 15km. The deepest large diameter exploration hole in Canada was a Shell hole drilled several years ago to 6km, taking 10 months and costing about $12M. Cost is very dependent on the buoyancy of demand; the cost today might be half that figure. The technology is transferable to hard rock areas, given consideration for suitable bits. Core is not easily obtainable, and some discussion ensued regarding selected sidewall coring following identificaiton of interesting zones through borehole logging.

4. Little technological development could be foreseen to extend these capabilities. Alloy rods would be used to go deeper. Bradley had tried the turbo drill concept to deviate a hole, but found it not too suitable and double the cost of conventional drilling (works wonders in Pennsylvania coal fields, apparently). Through an exchange program, a USSR turbo drill had been loaned for Canadian oil field trials, but it met with little success, perhaps due to an apparent lack of quality control in its fabrication. While about 80% of drilling in the USSR uses the technique, only about 1% of North American drilling is done this way.

5. Artificial diamonds give better performance in drill bits than real ones.

6. Scientific objectives might be met with a judicious marriage of diamond drilling and oilfield technologies, especially in meeting the total depth requirement.

7. Gerhardt has a wireline sidewall corer capable of taking up to 12 little cores at one lowering; a typical cost is about $20k to take 6 cores. Core recovery by any means below 4000m may be difficult because of stress release problems causing core to 'disc' or to blow apart.

8. For deeper holes, pipe handling and bit changing is a major issue. This, and drill string design (material, threading) and maintenance is an area were some development is possible; this would represent a valuable spin-off benefit to the industry.

BOREHOLE STUDIES

Borehole geophysics/geochemistry was discussed at length. Generally, a suite of logs in excess of that used in the ocean drilling program would be required (see Taylor, 1985, for a discussion of the downhole measurement suite in the latter program). Logs might be taken over a considerable period of time, or easily repeated years later, if provision were made for a logging derrick to be built at the well. Most tools and software are fully developed, although some would need further development to miniaturize for use in diamond-drill size holes (e.g. the borehole gravity tool, presently no smaller than 10cm). Other problems, such as high downhole temperatures, are being tackled by other countries and through ODP. Participants in the Canadian RADWASTE program have developed an extensive logging expertise, but otherwise, it was recognized that the major contract well logging companies are non-Canadian.

Holes and pits for calibrating some downhole logging tools are being built by GSC (Killeen) at several strategic locations across Canada. This is an area of recognized Canadian expertise and further development would complement a scientific logging program.

RECOMMENDATIONS

Much technological detail changed hands at this meeting, and several general conclusions and recommendations were reached:

1. The program should avoid getting heavily involved in the advancement of drilling technology, as the overhead for such activity is quite large with success not guaranteed. The Canadian program lags similar programs in other countries and this is the time to import the technology, profitting from the expensive experimental drilling elsewhere.

2. Borehole logging technology in Canada should be encouraged, especially in the miniaturizing of existing tools for use in the smaller, diamond drillholes.

3. Technical experts from the drilling industry and the borehole logging industry should be invited to make presentations at the February meeting. These might include several of the participants in the present meeting (e.g. Killeen, Tyson (Kenting) and Skowronski (Bradley), and Beswick, if available; someone from the scientific drilling groups in the US or Europe might also be invited to share their first-hand experience, as might Roger Anderson, of the Borehole Measurements Group at Lamont. There is much to be gained by making the scientific community aware of the capabilities and limiting factors, such as discussed at this

meeting. Discussions with the geological community as to trade-offs (e.g. selected coring vs. continuous coring and value of chips rather than core at greater depths) should commence. The same community may not be aware of the geological knowledge that can be gained from use of the spectrum of downhole logging tools. At greater depths, mud logging, chip samples and borehole logging may well be all that is available.

4. Mr. Hans Maciez, the representative of the Canadian Petroleum Association, was encouraging about the industry's interest in this program, citing their very supportive role in getting Canada to join the Ocean Drilling Program. He suggested that industry is quite aware of the need over the long term of such fundamental investigations.

5. The participants recommended an initial drilling program designed within the current technological capability. Technological development could be a parallel activity, leading to deeper drilling after several years. This would maximize the advantage that might be gained from watching other countries' programs, and would assist the longer term funding prospects through getting some good science done early.

REFERENCES

Drury, M.D., 1985. Notes from a meeting to discuss geological problems that would benefit from a continental deep drilling program. Gravity, geothermics and geodynamics, file 6310-10, July , 1985.

Taylor, A.E., 1985. Comments on a meeting of the Downhole Measurements Panel of the Ocean Drilling Program, Halifax, June 1985. Gravity, Geothermics and Geodynamics, Internal Report 85-17 (12 pp + attachments).

LIST OF PARTICIPANTS AT MEETING

Arthur Darnley	GSC
Matt Salisbury	Dalhousie
Pat Killeen	GSC
Al Taylor	EPB
Bob Clarke	CANMET
Edo Nyland	Univ. of Alberta
Peter Fritz	Univ. of Waterloo
John Beswick	Kenting Drilling
Al Tyson	Kenting Drilling
Hans Maciez	Canadian Petroleum Association
Henry Skowronski	Bradley Brothers
Bill Baynton	JKS Boyles
Barry Krause	Inco
Harold Seigel	Scintrex