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MAR 30 1983

WMHT: 3102

MEMORANDUM FOR: Seth M. Coplan
 High-Level Waste Technical
 Development Branch
 Division of Waste Management

FROM: Mark Logsdon
 High-Level Waste Technical
 Development Branch
 Division of Waste Management

SUBJECT: SAMPLING OF DISSOLVED GASES AND GEOSTATISTICAL
 ESTIMATION

At the NRC-DOE workshop on geochemistry, held at Los Alamos National Laboratory (LANL) on January 12-13, 1983, I agreed to recommend to LANL some sources of information on sampling of dissolved gases and on geostatistical estimation. My recommendations are given below:

Sampling Dissolved Gases

My recommendations are based on discussions with Drs. Harold Bentley (University of Arizona), John Cherry (University of Waterloo) and Robert Fournier (U.S.G.S.). Systems to consider include:

- (1) Klyen sampler (Geothermics, Vol. 2, p. 56-60, 1973). The Klyen sampler is the most widely used down-hole sampler in the commercial geothermal industry. It is available off the shelf from Forgen-Jones, Ltd., Auckland, New Zealand.
- (2) Los Alamos sampler (Archuleta, Fink and Kurtenbach, Informal Report LA-7152-MS, February, 1978).
- (3) U.S.G.S. sampler (Fournier, U. S. Geol. Survey Professional Paper 750-C, p. C146-150, 1971).

In addition, there is a very promising sampling system designed by the National Hydrologic Research Institute of Environment Canada. I am trying to obtain information on this system from

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the designer; I will forward the information as soon as it is available.

PNL has published a recent review of sampling methods:

Watson, J.C. (ed.), "Sampling and Analytical Methods for Geothermal Fluids and Gases," Pacific Northwest Laboratory, PNL-MA-572 (UC-66d), 1978.

Additional information on procedures and equipment is found in:

Ball, J.W., E. A. Jenne, J. M. Burchard and J. M. Truesdell, "Sampling and Preservation Techniques for Waters in Geysers and Hot Springs," Proc. 1st Workshop on Sampling Geothermal Effluents, EPA-600/9/76-011, p. 218-234, 1976.

Phillips, F.M., Noble Gases in Ground Water as Paleoclimatic Indicators, unpublished Ph.D. dissertation, University of Arizona, 1981.

In general, down-hole sampling should be considered the state-of-the-art technique, both because it reduces the risk of atmospheric contamination and because it permits sampling of known intervals. DOE also should consider down-hole sampling for collecting samples for carbon-14 dating using accelerator technology, for which assurance of no contamination by atmospheric CO₂ is essential.

Geostatistical Estimation

There are numerous references on techniques of geostatistical estimation, though they are mostly in the mining and hydrologic literature. Good starting points are:

David, M., Geostatistical Ore Reserve Estimation. New York: Elsevier Scientific Publishing Co., 1977.

Doctor, D. C., "An Evaluation of Kriging Techniques for High Level Radioactive Waste Repository Site Characterization," Pacific Northwest Laboratory, PNL-2903, 1979.

Huijbrigts, C. and Matheron, G., "Universal Kriging (an Optimal Method for Estimating and Contouring in Trend Surface

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Analysis)," in Decision Making in the Mineral Industry, Canadian Institute of Mining and Metallurgy, Special Volume 12, p. 159-169, 1971.

Ripley, B.D., Spatial Statistics. New York: J. Wiley & Sons, 1981.

Whitten, E. H. T., "The Practical Use of Trend-Surface Analyses in the Geological Sciences," in J. C. Davis and M. J. McCullagh (eds.), Display and Analysis of Spatial Data. New York: J. Wiley and Sons, 1975.

Each of these references contains numerous citations for further information. The David book includes numerous examples and problems. LANL also might consider contacting Dr. Alan Gutjahr, (New Mexico Insitute of Mining and Technology, Socorro, NM 87801). Gutjahr is a distinguished applied mathematician whose principal area of research is in probabalistic methods applied to groundwater, and he is located close enough to Los Alamos to be a useful resource.

"ORIGINAL SIGNED BY"

Mark Logsdon
High-Level Waste Technical
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