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January 9, 1990

Dr. Anthony W. Gorody
Senior Scientist
Basic Research
Gas Research Institute
8600 West Bryn Mawr Avenue
Chicago, Illinois 60631

Subject: Contract No. 5089-260-1855
Monthly Technical Report

Dear Dr. Gorody:

Enclosed are four copies of the Monthly Technical Report for the month of December 1989. Also attached is a memo from M. L. Allison reporting the amount of time he has spent on the project.

We wish to thank you and the other GRI personnel who have helped in getting this project operational.

Sincerely,

DL Nielson

Dennis L. Nielson
Associate Director

Enclosure

cc: M. L. Allison
J. B. Hulen
W. L. Forsberg
D. A. Petty
P. M. Wright

encls.

# DEFINITION OF STRATIGRAPHIC HETEROGENEITY USING DIPMETER LOGS

Monthly Report
December 1, 1989 through December 31, 1989

Prepared By:

THE UNIVERSITY OF UTAH RESEARCH INSTITUTE

Jeffrey B. Hulen
M. Lee Allison
Dennis L. Nielson
Wilford Forsberg

For

GAS RESEARCH INSTITUTE

Contract No. 5089-260-1855

GRI Project Manager
A. W. Gorody

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GRI December Monthly Report

## 1.0 Work Planned for the Month

Work for December 1989 involved measurement of additional Ferron Sandstone sections in a marine-dominated portion of the unit at the Dry Wash site, in section 34, township 21 south, range 7 east, near Moore, on the southwestern flank of the San Rafael upwarp in central Utah. Attitudes of various planar and curviplanar features measured in the Ferron sections at the Dry Wash site were plotted as synthetic dipmeter logs and SCAT diagrams, then compared with corresponding information from the fluvial-dominated Ferron sections at the Muddy Creek site, a few miles south, measured during the month of November.

## 2.0 Work Completed During the Month

Two sections at the Dry Wash site, one complete and one partial, were measured during the month. Adverse winter conditions confined field time to four days (December 5-8). Nonetheless, one of the two Dry Wash sections, 92.5 ft in thickness, provided an unusually complete set (several hundred data points) of dip magnitudes and azimuths for preparation of simulated dipmeter logs as well as SCAT plots and analyses. A second section at the site, yet to be completed, promises equally abundant and useful Ferron Sandstone dip data.

The Ferron Sandstone at The Dry Wash site (stop 1 in the fieldtrip guidebook "Facies Analysis of the Ferron Sandstone, San Rafael Swell, Utah"; UURI, August 1989), site comprises marine- rather than fluvial-dominated facies as measured in November at the Muddy Creek site. Thick, upper-shoreface delta-front and distributary mouth-bar sandstones at Dry Wash, display prominent trough cross-stratification like their fluvial-channel counterparts at the Muddy Creek site. Simulated standard downhole dipmeter logs for comparably thick fluvial and distributary mouth-bar sandstone sequences are quite similar, with dip angles showing a range of about 28°. Corresponding rose diagrams of dip azimuths for the two sandstone types, however, reveal a much stronger preferred orientation for the mouth-bar sandstone at the two sites studied to date.

This is believed to reflect a greater tendency for fluvial channels to shift dramatically with time; we stress that this interpretation is preliminary and subject to modification as more data from similar sandstone sequences are acquired and processed. Dip vs. azimuth (DVA) SCAT plots for the measured mouth-bar and fluvial-channel sandstone sequences also differ. The fluvial sandstones display a broad range of dip azimuths at low angles, and a tendency to cluster into narrower azimuth ranges at higher angles. Corresponding data for the mouth-bar sandstones are much more tightly clustered and lack the low-angle azimuthal "spread" of the fluvial rocks. The distinctive difference between the bulk curvature patterns is supportive of our theory of defining stratigraphic bodies using SCAT. Whether these differences are definitive will take continued data collection and analysis.

The upper portions of both the Dry Wash marine-dominated and the Muddy Creek fluvial-dominated sandstones display prominent contorted lamination; the simulated dipmeter signatures of these contorted strata are very similar, with a broad range of both azimuths and dip angles. Lower-shoreface delta-front sandstones at the Dry Wash site are also very locally contorted, with equally anomalous simulated dipmeter signatures.

One other preliminary conclusion which can be drawn from our Ferron studies is that some basic dipmeter interpretation rules (e.g. Gilreath, 1987, for Schlumberger, Ltd.), although certainly useful and generally applicable, are unrealistically simple or inaccurate. For example, point bar deposits are listed as having dip azimuths oriented in the direction of current flow and varying $\pm$ 60° (a 120° spread). However, data from our Muddy Creek fluvial channel sections (including point-bar deposits) suggest that bed boundaries, which would likely be detected by the dipmeter, show a much greater range in dip azimuth — at least 180° and perhaps more. Similarly, distributary mouth-bar sandstones thus far examined for this project show a much greater range of dip azimuths than most dipmeter guides would suggest.

## 3.0 Associated Work

None

## 4.0 Problems Encountered

None, except perhaps adverse winter field conditions

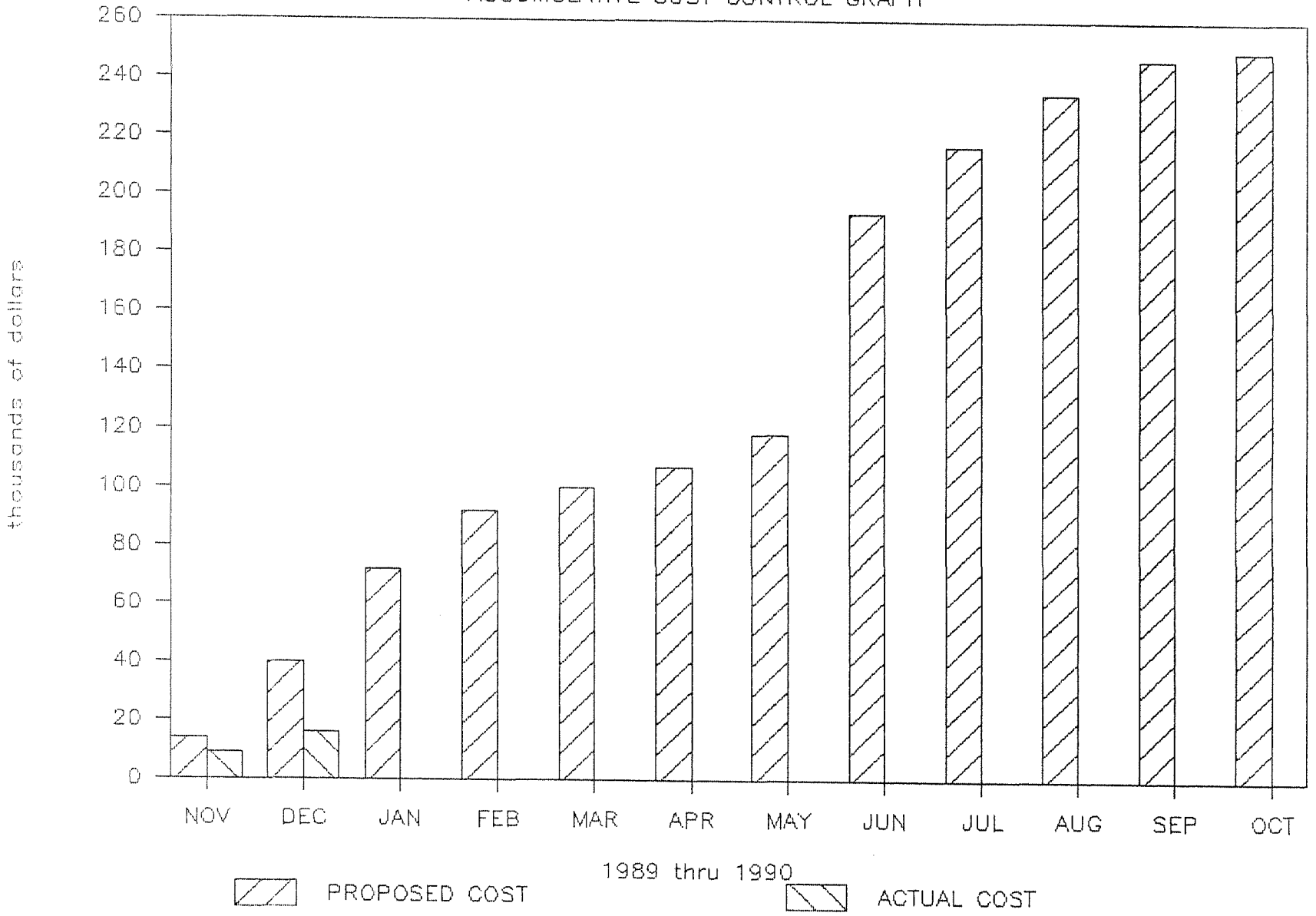
## 5.0 Work Planned for Next Month

Fieldwork for the project is unlikely during January. We will therefore concentrate our efforts into further analyses, comparing conventional and SCAT dipmeter plots, of the Ferron Sandstone data we have collected to date. Fieldwork will resume at the earliest opportunity (probably late February, although relatively warm weather can occasionally prevail as early as mid-January).

SCAT software is on order and all data will be entered to be plotted by it. Stratigraphic analysis will be initiated by Marjorie Chan, and C. A. Bengston will study the SCAT plots. If their results are completed early enough we will begin synthesizing the various components of the study.

# UNIVERSITY OF UTAH RESEARCH INSTITUTE

## ACCUMULATIVE COST CONTROL GRAPH



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MEMO

January 8, 1990

To: Dennis Nielson
From: M. Lee Allison
Re: Time on GRI project

The following is the time I have officially spent on the GRI-sponsored project "Definition of Stratigraphic Heterogeneity from Dipmeter Logs" for November and December, 1989. Unless otherwise noted the time was spent at UURI determining field and lab procedures or analyzing data.

| Date | Hours | Topic |
|---|---|---|
| 11-1-89 | 2 | |
| 11-3-89 | 1 | |
| 11-10-89 | 3 | |
| 11-13-89 | 2 | Preparation for field work |
| 11-14-89 | 8 | Field work, Ferron outcrops |
| 11-21-89 | 2 | |
| 11-27-89 | 2 | |
| 12-1-89 | 2 | |
| 12-3-89 | 4 | Discuss data with C.A. Bengston |
| 12-12-89 | 1 | |
| 12-15-89 | 1 | |
| 12-28-89 | 2 | |
| Total | 30 hours | |

| | | |
|---|---|---|
| Salary and benefits | $26.49/hour for 30 hours = | $794.70 |
| G & A 30.2% | | 240.00 |
| Total | | $1034.70 |

This is the UGMS cost share to the project through 1989.