ADDENDUM TO:

# PRELIMINARY RESULTS OF MINERALOGY AND PETROLOGY OF THE COZZETTE INTERVAL (DEPTH 7871-7957 FT) DRILL CORE MWX-1 JULY 20, 1982

AND

# PRELIMINARY RESULTS OF MINERALOGY AND PETROLOGY OF THE CORCORAN (8105-8128 FT) AND COZZETTE (7832-7898 FT) INTERVALS DRILL CORE MWX-2 AUGUST 31, 1982

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This addendum is in response to the U.S.G.S. report on the Corcoran and Cozzette Intervals, MWX-1 and 2, dated January, 1983. The report implied that the clay mineral which was identified by the Bendix Field Engineering Corporation Petrology Laboratory as kaolinite may be a special variety of high iron chlorite. This variety of chlorite is not well documented in published literature and is almost always identified as kaolinite by those unfamiliar with its occurrence. It is essential to differentiate between these two minerals because of their difference in reaction during well stimulation. Kaolinite is relatively nonreactive with acids while a chlorite-acid reaction is potentially damaging to the reservoir.

After much discussion with C.W. Spencer, J.K. Pittman, and R.M. Pollastro of the U.S.G.S. it was concurred that it is unlikely that kaolinite occurs in the abundance indicated by X-ray diffraction analysis. Reasons for this include: kaolinite does not occur in sufficient quantity in thin section to account for a greater abundance than chlorite; and the paleo-temperatures in the Cozzette Formation were probably too high for kaolinite to remain stable. Therefore, after discussion with Sandia personnel it was decided that further investigation of these clay minerals was necessary.

The simplest method of determining whether kaolinite or chlorite is present is to digest clay-size separates in acid. Chlorite is soluble in acids such as nitric and hydrochloric while kaolinite is relatively insoluble in these acids. X-ray diffraction (XRD) analyses can be performed on clay separates before and after acid treatment.

Characteristic XRD patterns for kaolinite have 7 Å [001] and 3.55 Å [002] reflections, whereas chlorite XRD patterns have 14 Å [001], 7 Å [002],

4.7 Å [003], and 3.55 Å [004] reflections. In high iron chlorite minerals the [001] and [003] XRD reflections are depressed and may be nonexistent. The [002] and [004] XRD reflections in these chlorites is enhanced giving the appearance of a kaolinite XRD pattern. If chlorite is the principal clay mineral it would dissolve in acid. As a consequence its corresponding XRD reflections would not be present and any residual 7 Å and 3.55 Å reflections would be due to kaolinite.

PROCEDURES

The clay-size fractions were separated from two samples representative of the Cozzette Interval (7871.2 ft and 7911.5 ft) in which significant kaolinite was originally identified. Two clay separates were made as control samples to insure that the XRD results from the original Cozzette Interval report could be duplicated. The remaining clay-size material from the two samples was removed from suspension by filtering through a millipore filter system. This fraction was re-dispersed in a 6N Nitric acid solution at room temperature. Samples of the acid treated clay-size fraction were analyzed by XRD after 24, 72, and 144 hours.

RESULTS

XRD results of the control samples were nearly identical to those obtained for the original Cozzette Interval report. The results of these analyses are presented in Charts 1 and 2. It can be noted that significant 7 Å and 3.55 Å reflections are present while the 14 Å and 4.7 Å reflections are relatively minor. Upon heating to 550°C a significant collapse of the 7 Å and 3.55 Å peaks occurred leaving small residual peaks. The 4.7 Å peak totally collapsed while the 14 Å peak was relatively unchanged. This was originally interpreted as a typical result for abundant kaolinite and minor chlorite, with the chlorite

structure being partially unstable during heating causing a partial collapse of the chlorite structure. (The reflection at about 10 Å is for illite and illite/montmorillonite.)

After acid treatment for 24 hours XRD analyses of the clay fractions showed a significant reduction in the size of the 14 Å, 7 Å, 4.7 Å, and 3.55 Å reflections. All of the XRD reflections corresponding to either kaolinite or chlorite disappeared after 72 hours for the sample from 7871.2 ft and 144 hours for the sample from 7911.5 ft. The final results are presented in Charts 3 and 4. The shift in the illite reflection was expected and is insignificant to this experiment.

CONCLUSIONS

This experiment is conclusive if we assume that the kaolinite, if present, would have been insoluble in the acids used. The conclusion is that there is very little, if any, kaolinite present in the samples representative of the Cozzette Interval. The clay mineral originally interpreted as kaolinite is probably the high iron variety of chlorite as suggested by U.S.G.S. personnel. This is probably also true for the Corcoran Interval.

It is suggested that a control sample for each interval in which significant kaolinite has been identified be subjected to an acid treatment similar to the one performed in this experiment. This would give a more realistic interpretation as to the relative ratios of kaolinite to chlorite. Kaolinite is present in significant amounts in the Fluvial Intervals. The presence of the kaolinite has been confirmed by thin section analyses. However, chlorite may be present in more significant proportions than originally interpreted.

As this experiment is time consuming and requires more sample than routinely submitted to this laboratory, the extent of the continued use of this procedure should be by directive from Sandia personnel.

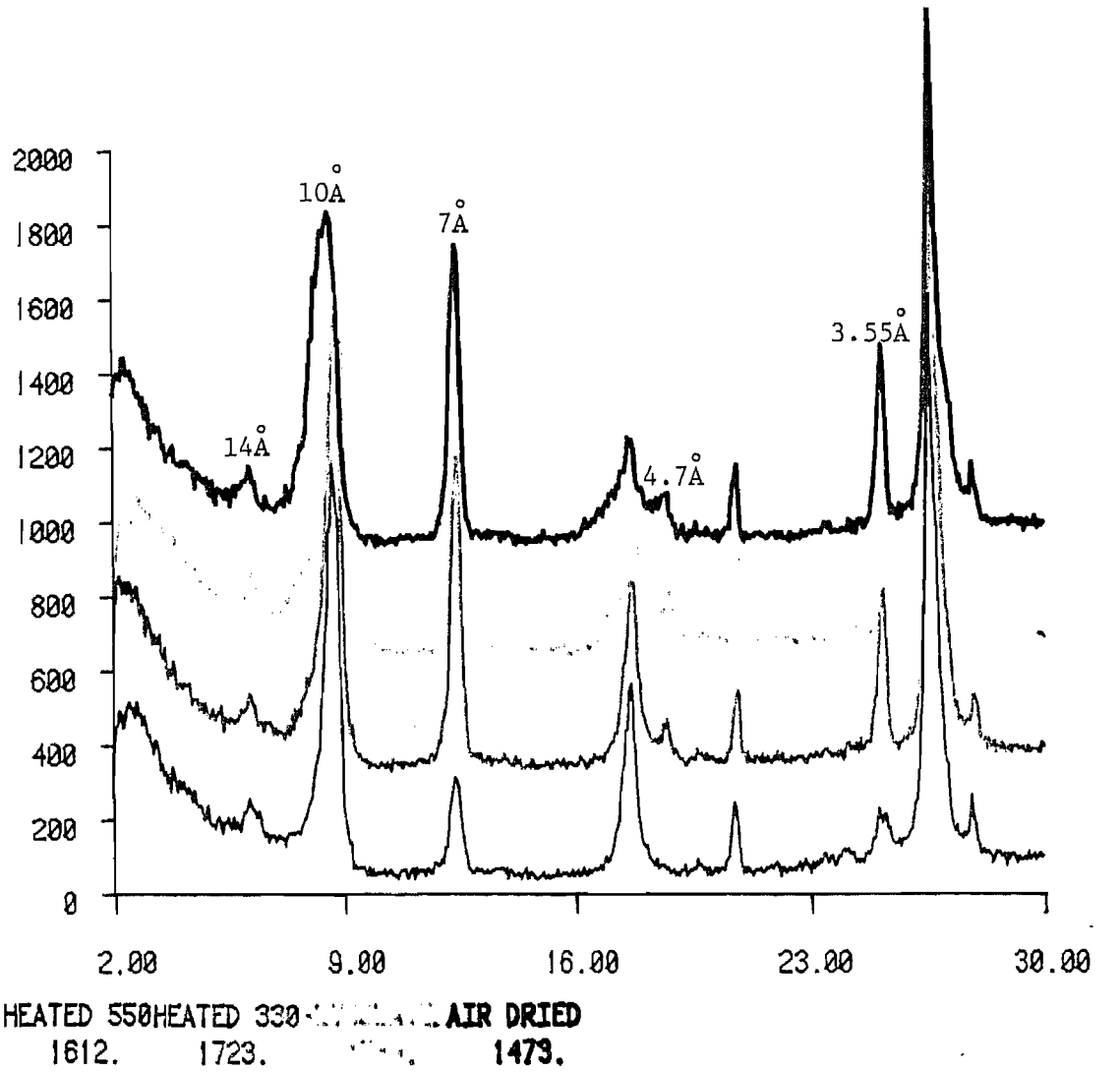
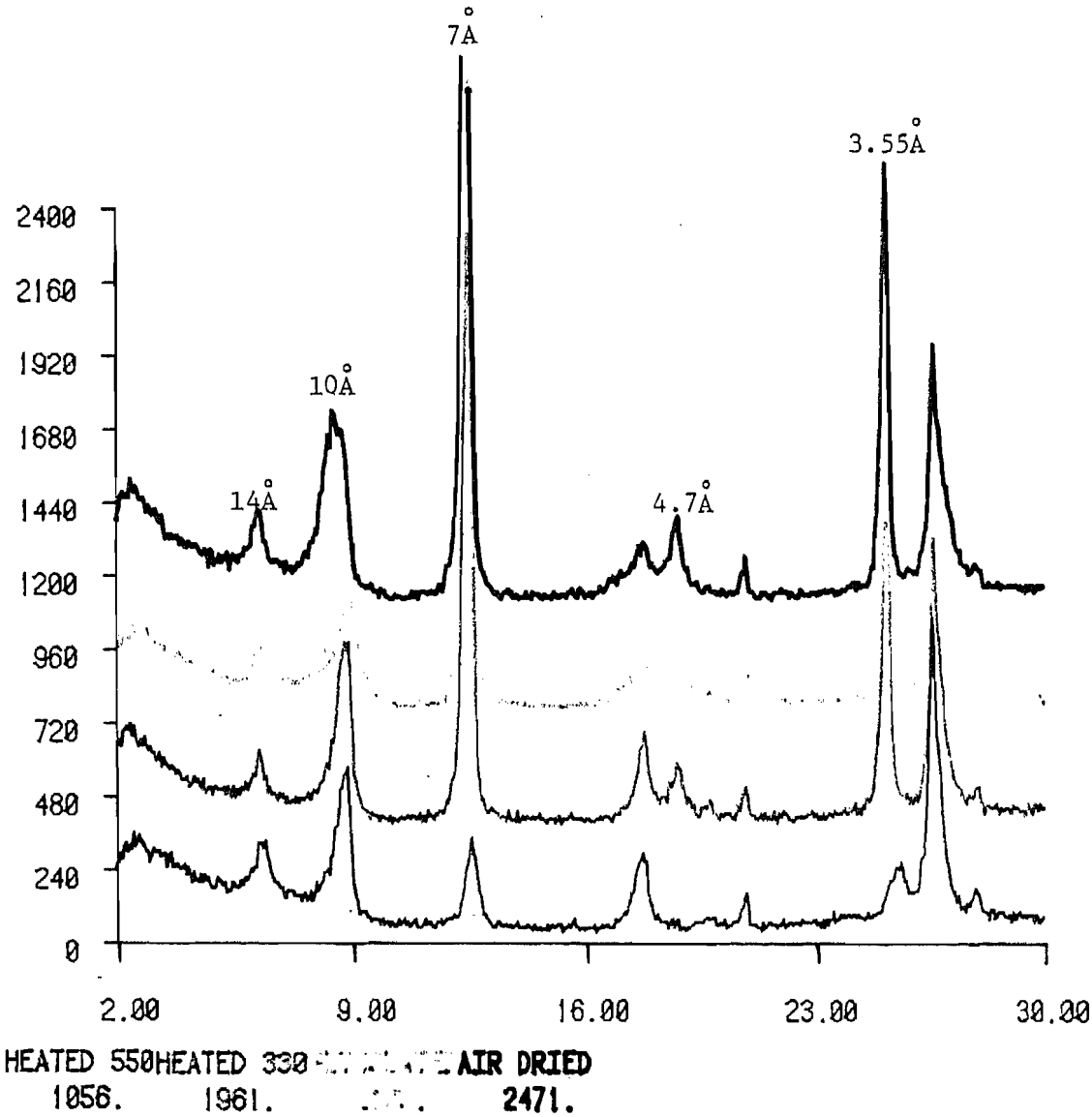
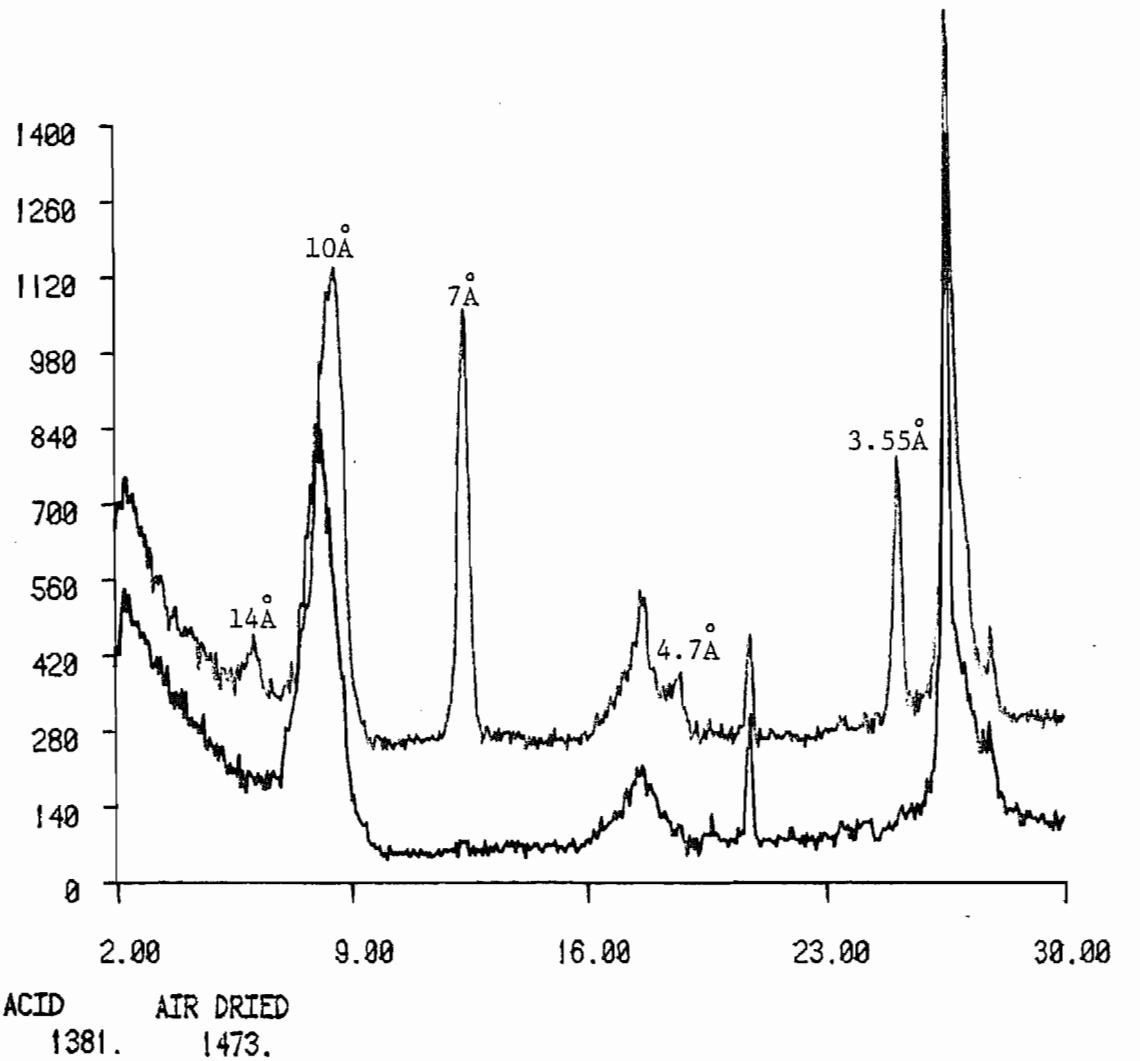



Chart 1. X-ray diffraction patterns of clay-size separates 7871.2 ft. Top to bottom: Air-dried; glycolated; heated to 330°C; and heated to 550°C.




APPENDIX

Chart 2. X-ray diffraction patterns of clay-size separates 7911.5 ft. Top to bottom: Air-dried; glycolated; heated to 330°C; and heated to 550°C.




APPENDIX

Chart 3. X-ray diffraction pattern showing destruction of chlorite XRD reflections after acid treatment. 7871.2 ft. Top: air-dried; bottom: after 72 hours in acid.

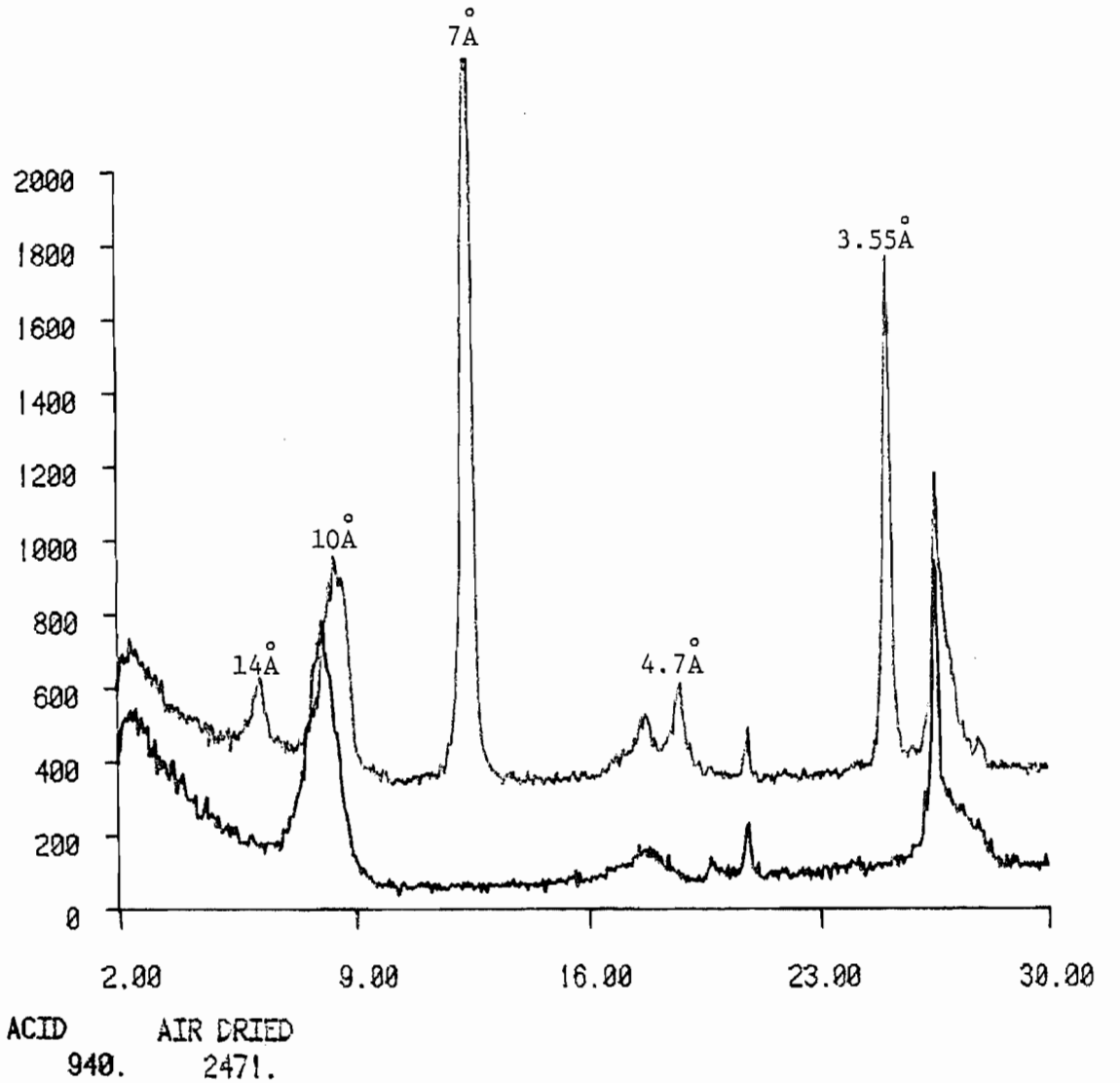



Chart 4. X-ray diffraction pattern showing destruction of chlorite XRD reflections after acid treatment. 7911.5 ft. Top: air-dried; bottom: after 144 hours in acid.