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ON THE CORRELATION BETWEEN THERMOGRAVIMETRIC RESPONSE AND POTENTIAL OIL YIELDS FOR GREEN RIVER OIL SHALES

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ABSTRACT

The thermogravimetric (TG) assay method previously proposed [1] to measure potential oil yields of oil shale samples has been extended to include samples from the Logan Wash, Rock Springs and Vernal deposits in the tri-state area. The key result emerging from this study is that the correlation previously shown between Fischer assay and percent weight loss at 500°C remains valid regardless of the particular depositional area in a given formation.

In a previous paper from this laboratory [1], a thermogravimetric (TG) assay method was proposed wherein potential oil yields of oil shale samples could be readily determined from the measured percent weight loss at 500°C. A suite of six oil shale samples from the Anvil Points mine in Colorado was selected for this study. A major requirement for the proposed assay method to be effective was that the ratio of gas yield to oil yield be essentially constant over a wide range in the oil yield of the sample. With the expectation that this ratio should not vary much for shale samples from the same geological formation, a further series of samples from the tri-state area was included to test the correlation. The new results, together with the previous data on Anvil Points Shales, are presented in this brief note in an attempt to underline the generality of the proposed assay tool.

Details on shale origin and sample preparation may be found elsewhere [2,3]. The Anvil Points samples were those utilized in the previous study [1] and the data on these are included here only for comparison. Table 1

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TABLE 1

Description of Green River oil Shale samples for the correlation shown in Fig. 1

Sample designation	Origin	Approximate range of oil yield (l tonne^{-1})
A	Anvil Points, Rifle, CO (cf. ref. 1)	40–520
B	Logan Wash, CO	50–230
C	Rock Springs, LETC Test Site No. 10, WY	70–130
D	Vernal, UT (Geo-Kinetic field test site)	60– 90

provides a summary of the Green River Shale samples selected for the present correlation. As described previously [1], a DuPont 990 thermal analysis system fitted with the 951 TG accessory module was used for the experiments. All experiments were performed in a flowing atmosphere (nominal flow rate: ~ 300 l min^{-1}) of ultrapure N_2. A nominal heating rate of 10°C min^{-1} was employed although no dependence of percent weight loss on heating rate (over the range 2–50°C min^{-1}) was noted. The data presented below are those averaged from duplicate measurements on 'identical' samples. The maximum mean deviation in the estimation of the percent weight loss is shown as an error bar in Fig. 1 (vide infra). As before [1], the percent weight loss at 500°C was taken as a measure of the oil yields of the shale.

For correlation purposes, the oil yields were determined separately either by pulsed NMR [4] or by specific gravity measurements [5]. The precision of an oil yield determination is estimated to be ± 8 l tonne^{-1}.

Figure 1 illustrates the correlation between the two parameters, namely percent TG weight loss and oil yield for Utah, Colorado and Wyoming

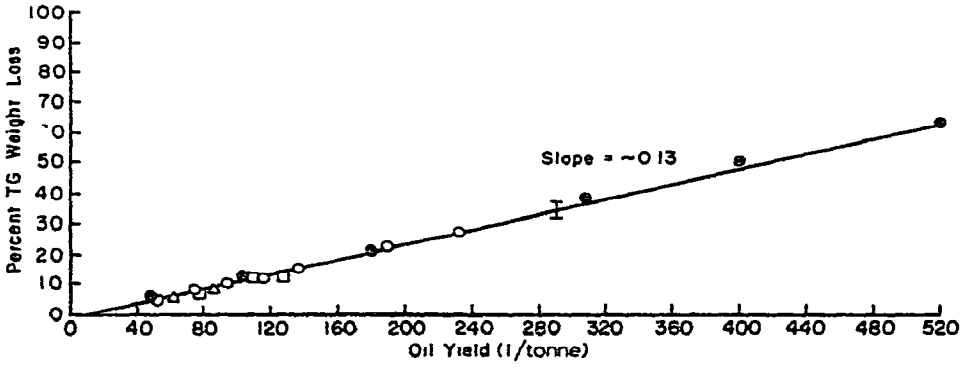

Fig. 1 Correlation between TG weight loss at 500°C with oil yield for Green River oil shales. The error bar denotes the maximum mean deviation in the measured TG weight loss values. ●, Sample A (cf. ref. 1); ○, sample B; □, sample C; △, sample D. Data on samples labelled "A" (cf. Table 1) are from ref. 1.

shales. The point to emphasize here is that a single straight line describes the relationship between the two parameters regardless of the particular location from where the shale sample originated. While this observation merely confirms the expectation that, for shales from the same formation, the indigenous kerogen should be characterized by comparable H/C ratios (and consequently comparable oil/gas yield ratios), it is quite encouraging to note the general validity of the proposed TG assay technique. In this regard, the main advantage is that a single master plot may be used for all unknown samples from a particular formation. Otherwise, the development of such plots for a large number of samples from specific depositional areas in each formation would have been a painstaking task indeed.

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