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**ASSESSMENT OF MICROFRACTURING
IN RIO BLANCO POSTSHOT CORE RB-AR-02**

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ASSESSMENT OF MICROFRACTURING IN RIO BLANCO POSTSHOT CORE RB-AR-02

ABSTRACT

Microfracturing in the two core sections recovered from the Rio Blanco RB-AR-02 postshot hole is very small. Significant differences could not be detected between the upper core (354-378 ft radial distance) and the lower core (181-188 ft radial distance). Sections of highly fractured core are all characteristically fine grained silts and clays. The fracturing within them appears to reflect release of stresses when the cores were "sledged" from the barrels. The comparable phenomenon in the coarser sandstones is grain boundary separation.

INTRODUCTION

Two cores were taken from a portion of the RB-AR-02 hole that entered the bottommost chimney created by the Rio Blanco gas stimulation experiment in Piceance Basin, Colorado. The drilling history has been summarized by Gleason¹ and a description of the macroscopic condition of the recovered cores has been given by McArthur.² This report is a summary of the microscopic effects of the explosion in the sandstones, siltstones, and shales of the Mesa Verde formation as seen in these recovered cores. Attention has been focused on the fracturing produced and its potential to increase the gas-bearing formations permeability.

LOCATION OF THE RECOVERED CORE

Figure 1 is a idealized drawing of the three shot points associated with the Rio Blanco experiment and the location of the two recovered cores in RB-AR-02. Table 1 contains tentative data derived from the experiment relating to the location of the cores.³

Table 1. Radial distance of the cores and other information.

Slant hole distance (SHD) (ft)	Recovered length (ft)	Percent recovered	Postshot radial distance (ft)
Core 6742 - 6766.7	24.7	92	354 - 378
Core 6931 - 6944	13	90	181 - 188
Lost circulation 6997	-	-	130
Cavity edge 7061	-	-	79

Fig. 1. Idealized drawing of Rio Blanco experiment together with predictions of permeability increase; modified from Ref. 4.

MACROSCOPIC CONDITION OF THE CORE

Figures 2 and 3 are photographs of the Rio Blanco core as received at the Lawrence Livermore Laboratory. McArthur has recorded a description of these cores at earlier times. It is noteworthy that fracturing continued after extraction from the core barrels presumably due to stress relief. This same phenomenon may explain the large amount of fracturing produced by the sledge hammers during removal from the core barrels (for example, see Fig. 2, 6932-6935 ft interval). Core does not necessarily break up with such removal techniques. It is not known whether such in situ stresses are shock induced or relate to local stress conditions in the preshot rock.

McArthur's observations include the fact that gross fractures tend to follow pre-existing planes of weakness, such as bedding and the regional joint system. These are seen as fractures at angles of 45-60° to the core axis (see Fig. 3, 6763.7-6766.7). Another notable type of fracture is essentially parallel to the core axis (see Fig. 3, 6747-6749.7 and 6749.7-6752.6). These are oriented radially with respect to the shot point and may be shot induced. Why such fracturing does not occur elsewhere in the lower core section is not clear.

MICROSCOPIC FRACTURING OF THE CORE

Twenty-four thin sections were cut from the core sections. Samples were taken at 1- to 2-ft intervals. Most were cut parallel to the core axis in order to intersect the bedding at a high angle. Some were also taken parallel to the core axis, and in these a slightly greater amount of fracturing was seen. Prior to sectioning, the core samples were impregnated with epoxy under pressure in order to minimize if not eliminate production of fractures during thin section preparation.

The numbers on the thin sections were hidden, and the samples were put in order according to the degree of fracturing observed under a petrographic microscope. When the numbers on the thin sections were restored, the order revealed that the two core segments could not be distinguished on the basis of the degree of fracturing.

Next, the individual samples were studied in detail. Each was assigned to one of four categories: unfractured, slightly, moderately, and highly fractured. This is a somewhat arbitrary classification, but it is believed to be satisfactory for comparison purposes. The aim was to determine whether there are any systematic changes along a particular core section. The results shown in Fig. 4 suggest that there are none.

Fracturing observed in the thin sections is of three sorts: large open breaks in the fine grained silts and clays [see Fig. 5 (a)]. These microfractures are found only in the highly fractured portions of the core and may be the unique response of fine grained sediments containing residual strain to the "sledging" that took place during core removal. The second kind of fracturing is essentially grain boundary separation. From Fig. 4, it can be seen to be restricted to the coarser grained sandstones. It is tempting to view this dilation as the coarser grain sandstones response to the "sledging" and concomitant stress release. The last type of fracture is one normally expected in

Fig. 2. Recovered core (2-5/8-in. diam) in interval 6931-6944 ft (slant hole distance).
Top: 6931-6932; middle: 6932-6935; bottom: 6935-6938.

Fig. 2. Continued. Top: 6938-6941; bottom: 6941-6944.

Fig. 3. Recovered core (2-5/8-in. diam) in interval 6742-6766.7 ft (slant hole distance).
Top: 6742-6744; middle: 6744-6747; bottom: 6747-6749.7.

Fig. 3. Continued. Top: 6749.7-6752.6; middle: 6752.6-6755.1; bottom: 6755.1-6758.1.

Fig. 3. Continued. Top: 6758.1-6760.9; middle: 6760.9-6763.7; bottom: 6763.7-6766.7.

Fig. 4. Microfracturing in RB-AR-02 cores.

(a)
100 μ

(b)
100 μ

Fig. 5. Types of fracturing: (a) open fractures in fine-medium grained siltstone (6761 ft, SHD); (b) microfracture in quartz of sandstone (6742 ft, SHD).

pervasively fractured rock Fig. 5 (b). It is an intergranular fracture that typically occurs in laboratory triaxial tests, especially those conducive to shear failure. It is poorly developed in the two core sections; about one-third of the samples examined contain this sort of fracture. It is too small to be detected in the photomicrographs of typical samples from the two core sections (Figs. 6 and 7).

DISCUSSION

At the outset of this study, it was believed that shock-induced fracturing could be distinguished from casual accidental breaks as well as from preexisting fracturing. The reason for this was the belief that shock-induced fracturing would be pervasive. By that is meant fracturing would be observed on all levels; i. e., macroscopic shear failure would have a counterpart on the microscopic level. This may well be the case for the Rio Blanco cores under study, but the degree of shock-induced fracturing is so low as to be seriously disguised by postshot deformation and by what appears to be release phenomena. The latter appear to be the most conspicuous fracture phenomena in both cores. Whether the strain released was deposited by the explosion induced stress wave or was present preshot is unknown. The well-known diskling phenomenon in deep cores, such as taken in the Lewis shale at the Gasbuggy site (GB-3), is the result of the same phenomena.

The best that can be said is that the amount of microfracturing in the gas-bearing sandstones of both recovered cores is very small. The isolated fractures are not through-going. Judging from the condition of the core fractures in the finer grained members of the suite, those portions of the core must have almost exploded on unloading and removal from the core barrels. Microfractures in these portions of the core are large and through-going.

Fig. 6. Photomicrographs of the upper core section: (a) - (e) fine- to medium-grained sandstones (6742, 6744, 6747, 6750, 6752.6 ft, SHD); (f) and (g) fine- and very-fine-grained siltstones (6756 and 6766.7 ft, SHD).

(e)

500 μ

(f)

(g)

Fig. 6. (Continued.)

Fig. 7. Photomicrographs of the lower core section: (a) shales (6931 ft, SHD); (b) - (d) very fine sandstones (6935, 6939, 6944 ft, SHD).

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