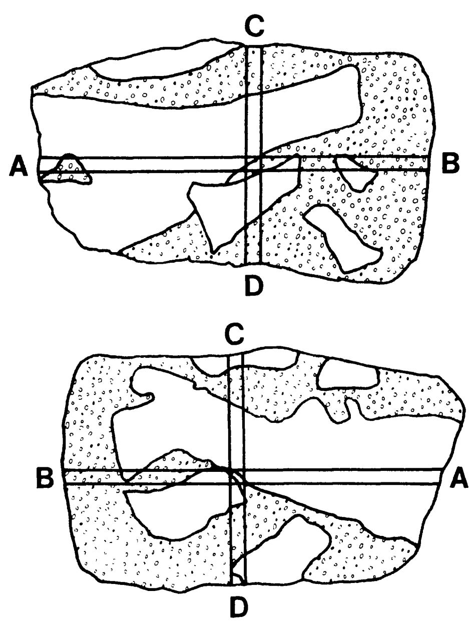
THERMOLUMINESCENCE OF A GAS-RICH METEORITE AND THE RELATIONSHIP BETWEEN GAS-RICH AND GAS-POOR METEORITES. Derek W.G. Sears, Department of Chemistry, University of Arkansas, Fayetteville, AR 72701.

The thermoluminescence (TL) sensitivity of 79 samples from the Plainview gas-rich meteorite have been used to derive new information on the nature of the dark matrix. The samples came from two bars which had been cut from a 4 mm thick slice (BM 1959,805) measuring 4.0 x 6.5 cm (Fig. 1). An approximately equal number of samples were taken from the dark matrix and light clasts. The TL sensitivity was measured by heating the samples to 500°C, to drain their natural TL, and then giving them a 50 krad radiation dose from a ^{60}Co γ source prior to TL measurement.

TL sensitivity is very susceptible to small changes in the crystallography of feldspar, which is the TL phosphor. For example, type 3 meteorites have a TL sensitivity 10^{-5} (type 3.0) to 10^{-2} (type 3.9) times that of type 6 meteorites (Sears <u>et al</u>., 1980) and shock-blackened ordinary chondrites have a TL sensitivity $\sim 10^{-2}$ times that of unshocked meteorites of the same petrologic type (Sears, 1980). Fig. 2 shows how the TL sensitivity varied along each bar; open circles refer to samples taken from light clasts, filled circles to dark matrix samples and dots refer to samples which are matrix on one side of the slice and clast on the other. The average TL sensitivity of samples from dark matrix was 1.36 ± 0.48 (where the units are arbitrary and



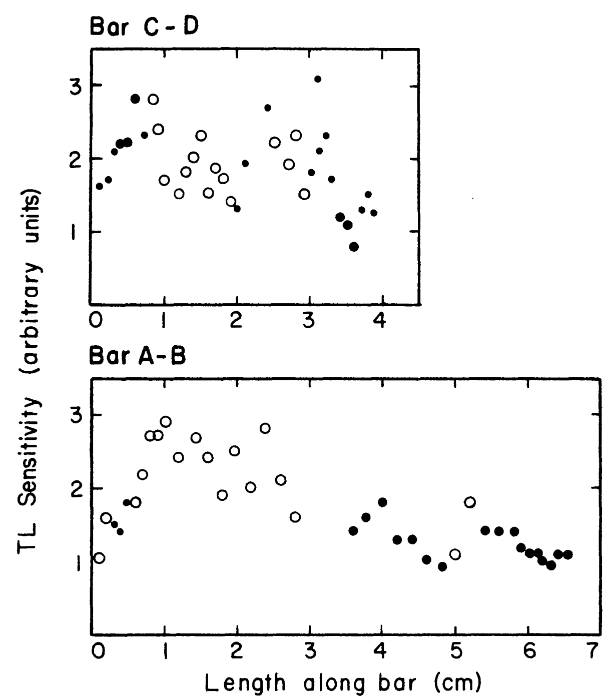


FIG. 1 (left) The 4.0 x 6.0 x 0.4 cm slice from the Plainview meteorite used for the present study. The light clasts, dark matrix and sampling bars are indicated. Fig. 2 (right) TL sensitivity along the two bars shown in Fig. 1. Filled circles refer to dark matrix samples, open circles to light clast material and dots to samples which were matrix on one side of the slice and clast on the other, or were otherwise uncertain.

the errors are one standard deviation). For the clasts these figures are 2.02 ± 0.50. It is concluded that a major fraction of the material in the dark matrix is relatively unshocked and comparable to the clasts in the extent of equilibration. The slightly lower TL in the matrix may be due to 1) the lower albedo of the matrix, since much of the TL detected will have suffered multiple reflections with grain surfaces, or 2) the equilibrated material being diluted with an equal amount of material with much lower TL; the dilutant could be either type 3 material (Noonan and Nelen, 1976; A. Rubin, per. comm.) or clast material whose feldspar has been turned to maskelynite by the regolith process (Ashworth and Barber, 1976). Expanation (1) is thought unlikely, since, to the naked eye at least, the albedo difference in these samples is very subtle. Whichever is the case, it is concluded that at least ∿70% of the dark matrix is as equilibrated as the clasts.

The source of the equilibrated material in the dark matrix is probably comminuted clast material. In contrast, the matrix of Mezö Madaras, a gas-poor breccia, has a TL sensitivity consistent with its type 3 assignment (Sears et al., 1980; Binns, 1968; Van Schmus, 1967). Gas-rich breccias also differ from gas-poor breccias in being rich in solar gases, charged-particle tracks and carbon (Suess et al., 1964). On the other hand, gas-rich and gas-poor breccias are similar in that they are both surface regoliths, evidence for this is their structure and the presence of shocked and xenolithic fragments in the matrix. The degree of comminution of the matrix, the abundance of solar wind carbon and the amount of glass have been used as indices of regolith maturity in lunar studies (e.g., King, 1977). It is therefore suggested that the main difference between gas-rich and gas-poor meteorite breccias is that the former come from much more mature regoliths (Sears, 1981).

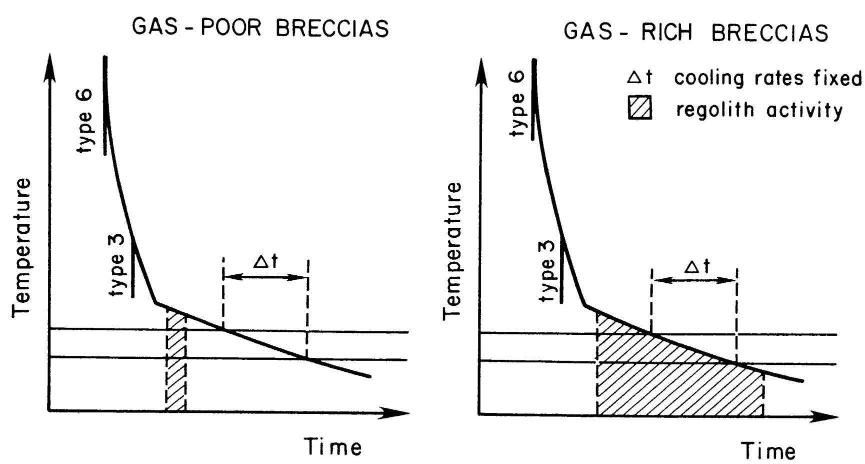


FIG. 3 Schematic diagrams to show a possible relationship between gas-rich and gas-poor meteorite breccias. It is suggested that the difference is one of regolith maturity and that brecciation continued until temperatures had fallen below those at which metallographic cooling rates are fixed in the case of gas-rich meteorites.

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Metallographic data have been published for eight regolith breccias, three gas-poor and five gas-rich (Wood, 1967; Scott and Rajan, 1980). One may generalize from the data that gas-poor breccias produce coherent metal composition plots, while gas-rich breccias do not; incoherent composition-dimension plots may imply brecciation after cooling below the temperatures at which metallographic cooling rates were fixed. This observation is consistent with a maturity difference between gas-rich and gas-poor breccias and suggests the time-temperature histories in Fig. 3.

The matrix of gas-rich breccias may be of any petrologic type (see Keil, this volume, for specific examples). The many type 3 meteorites which contain true xenoliths and equilibrated clasts are also regolith breccias and at least one even contains solar wind gases (see Scott and Taylor, this volume). Apparently, these generally gas-poor meteorites are immature regolith breccias which, after appropriately long regolith lifetime, would resemble gas-rich meteorites like Dimmitt, with a low petrologic type matrix. Dimmitt even contains graphite-magnetite inclusions similar to those found in certain type 3 meteorites; the more delicate type 3 characteristics, such as fine-grained ("Huss") matrix, would almost certainly not survive regolith activity for very long. I believe it is misleading to term such meteorites "primitive breccias" as this implies the major difference between meteorites which are gas-poor and primarily type 3 (e.g., Mezö-Madaras) and those which are gas-rich and contain a matrix which is a mixture of type 3 material and comminuted matrix (e.g., Weston) is associated with metamorphism. In fact, the differences are associated with the maturity of the regolith.

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