Samples of polyethylene cocrystallized with less than 50 percent of n—$C_{32}H_{66}$ show a greater profusion of links than is found in the sample illustrated in the photograph on the cover. It is unlikely that crystallization will be drastically different in an undiluted high polymer in which, therefore, extrapolation leads us to expect an even greater number of links to be formed. Being highly oriented (in the molecular sense) and, because of their mode of formation, being firmly anchored to the crystals, these links should possess considerable strength.

It is interesting to note that, for polyethylene fractions of higher molecular weight, observed values of $l_{\max}$ are larger, by more than an order of magnitude, than root-mean-square values of the end-to-end lengths of the participating molecules as computed statistically (*3*). This may indicate that polymer molecules are much more extended in the melt than in dilute solution.

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Iron Minerals Formed by a Nuclear Explosion in a Salt Bed

Abstract. *The nuclear event, Gnome, was carried out in halite in the Salado formation and yielded a varied mineral assemblage. The iron support members reacted in the salt melt and formed several iron oxide phases. The magnetite which formed during the fireball stage reached in various ways with the environment to form higher oxides and hydrated oxides.*

The Gnome event was a nuclear explosion carried out at a depth of 361 m in bedded rocksalt in the Salado formation near Carlsbad, New Mexico, on 10 December 1961. Microscopic and x-ray examination of postshot drill cores sampled in the summer of 1963 and containing device debris showed a number of minerals which were not present before the shot. We want to draw particular attention to some of the iron-containing minerals which were identified; namely, magnetite (Fe_3O_4), hematite (α-Fe_2O_3), maghemite (γ-Fe_2O_3), goethite (α-FeO•OH), and lepidocrocite (γ-FeO•OH). Of these, only hematite was positively identified as being present in the formation before the event.

The main source of iron was several tons of structural steel which had been placed in the shot room before the event. Although the initial environment was probably conducive to chemical reduction owing to the presence of rather large amounts of paraffin, material of the walls of the room contributed to the fireball and rendered the atmosphere oxidizing: large amounts of H_2O and CO_2 were released as compared to only small amounts of H_2 and CO. It may, therefore, be assumed that magnetite, the dominant iron mineral formed, was a primary product of the reaction between metallic iron and oxygen from minerals such as anhydrite with the possible addition of water from the Salado formation.

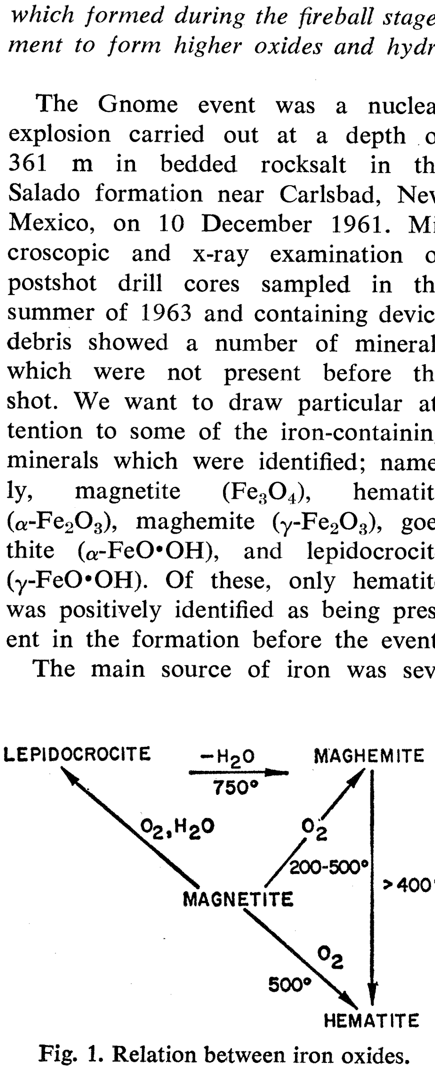

Fig. 1. Relation between iron oxides.

Magnetite has been usually, but not always, associated with considerable amounts of device debris. The presence of maghemite, lepidocrocite, and goethite are undoubtedly the result of secondary reactions which occurred after the temperature had dropped considerably. Figure 1 shows the relations between some of these minerals. Lepidocrocite can be formed by the oxidation of freshly prepared magnetite in the presence of water. Its dehydration below 750°C yields maghemite (*1*). The conditions of direct conversion of magnetite to hematite and maghemite have been discussed recently by Colombo *et al.* (*2*) and by Lepp (*3*). In particular, maghemite may be formed between 200°C and 500°C in the absence of hematite, and depending upon particle size and oxidation rate. Smaller particles and a large rate promote maghemite formation.

The conditions in the cavity shortly after the detonation were favorable for the formation of lepidocrocite, since a large amount of water vapor was present. Consequently, under these conditions it would appear that maghemite would not be formed by the dehydration of lepidocrocite. One might hypothesize that magnetite oxidation could occur in a salt melt containing sulfate as an oxidizing agent. The NaCl–$CaSO_4$ eutectic lies at about 740°C, and although this temperature may be reduced by the addition of K_2SO_4 and $MgSO_4$ (from polyhalite), temperature conditions are such that probably hematite rather than maghemite would result. If, however, lepidocrocite becomes engulfed by hot and perhaps partially fused rock, it may well become isolated from the surrounding atmosphere and become dehydrated with the formation of maghemite. In view of the violent partial cavity collapse which started within a few seconds after the explosion and which was completed within 3 minutes, such a mechanism would reasonably explain the occurrence of maghemite.

Presumably goethite is formed by an entirely different path, namely, the oxidation of solutions of iron (II) compounds. Since small amounts of austenite and α-iron were found, we propose that goethite is formed by reaction of metallic iron (i) with the melt followed by hydrolysis under the prevailing hydrothermal conditions in the cavity, or (ii) with subsurface waters since December 1961.

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