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Diamond growth by sulphide reduction of CO_2

MARX[1] proposed that natural diamonds were formed by a reduction of CO_2 and other theories have been proposed to explain their formation[2–6]. Carbon dioxide is a common constituent[7,8] and has been found as a gas in natural diamonds[9]. Marx proposed that pyrrhotite is active in the reduction process because it has been found as an inclusion in diamonds[10]. Furthermore, thermodynamic calculations showed such a reduction reaction to be energetically possible:

$$2FeS(solid)+CO_2(gas)=2FeO(solution)+S_2(gas)+C(diamond) \quad (1)$$

Diamond formation by this reaction probably would result in inclusions containing either free sulphur or sulphur compounds, or both. To test this theory experimentally, natural diamond was oxidised by pure oxygen at a high temperature. Any included sulphur would be converted to gaseous SO and SO_2 which could be detected by analysing the products with a research mass spectrometer. The instrument is about 10^5 times more sensitive than any other spectroscopic method[11] and lends itself well to a study of minute quantities of a gaseous substance.

The mass spectrometer used was a 15.25-cm radius 90° sector type magnetic scanning instrument. The instrument, calibration and experimental procedures have been described[12].

Diamond fragments (16 g) were used[9]. The diamond was placed in a quartz tube which was evacuated by an oil diffusion pump to 10^{-7} torr. An oxygen atmosphere of 1 torr was then admitted to the sample tube. The sample was heated to a temperature of 1,050° C and maintained at that temperature for 45 min. The sample container was then placed in a dry ice–acetone bath and noncondensed components were removed by evacuation. Condensable substances were retained in the container. The remaining sample was analysed at room temperature using mass spectromatic techniques. Each experiment was duplicated three times. The weight of diamonds oxidised in each experiment was about 5.3 g.

No evidence for SO and SO_2 in the oxidation products was found in any of the three samples. The 16 g of oxidised diamond fragments comprised several hundred individual diamond crystals, some with visible inclusions, from Africa, Brazil and Arkanas. The detection sensitivity for sulphur was approximately 1 part in 10^9 with respect to other oxidation products. Thus, there was no evidence for the presence of pyrrhotite. This suggests that the reduction of CO_2 by pyrrhotite is not responsible for the formation of all natural diamonds. These limited data do not, however, rule out the possibility of some diamond formation by the reduction of CO_2 by pyrrhotite.

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R. E. LANGFORD
CHARLES E. MELTON
Department of Chemistry,
A. A. GIARDINI
Department of Geology,
University of Georgia,
Athens, Georgia 30601

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BIOLOGICAL SCIENCES

E. coli lactose operon ribosome binding site

IN *Escherichia coli*, protein synthesis is initiated with formylmethionine, coded by the triplet AUG. As the first step in translation, ribosomes bind to the AUG initiator codon in the presence of initiation factors, charged fMet-tRNA and GTP. The sequence or structure of a messenger RNA molecule must signal that a particular AUG triplet is an initiation codon, and the cell's ribosomes must recognise this region as containing a signal for initiation of translation. In a reaction suitable for *in vitro* protein synthesis, except that it contains only one species of charged tRNA, fMet-tRNA, ribosomes bind to and protect initiation regions from nuclease digestion. The ribosomes bind at the AUG initiator codon and cannot proceed any further due to the lack of charged tRNA species other than fMet-tRNA. In the hope of determining the characteristics peculiar to an initiation region in a mRNA molecule, a number of ribosome binding sites have been sequenced[1–8].

I have previously reported the sequence of the first 63 bases of the lactose operon mRNA transcribed from the (CAP-independent) UV5 promoter mutant[9]. Figure 1 shows this sequence. The first AUG triplet occurs at positions 39–41, and the succeeding bases, read in triplets, code for the first seven amino acids of β-galactosidase[10]. This was highly suggestive that translation might initiate at position 39 of he UV5 *lac* message, and that ribosomes should bind to and protect the surrounding region of RNA from nuclease digestion.

To verify that the region around the AUG codon at position 39 is a ribosome binding site, I have isolated the portion of the UV5 *lac* mRNA which ribosomes protect from digestion by RNase A (which cuts after C and U) and RNase T_1 (which cuts after G). Table 1 lists the