FINAL TECHNICAL REPORT
for a
THEORETICAL INVESTIGATION OF ISOTOPIC ANOMALIES OF
XENON IN TERRESTRIAL AND EXTRA-TERRESTRIAL SAMPLES
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by

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PRINCIPAL INVESTIGATOR: D. D. Sabu, Professor
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The work performed under the auspice of this grant is described in the six publications as follows:

1. Xenon in Carbonaceous Chondrites, Nature-Physical Science, vol. 240, pp. 99-101, 1972.

2. Solar Wind Xenon in Some Carbonaceous Chondrites, Journal of Geophysical Research, vol. 78, pp. 3245-3248, 1973.

3. Trapped Xenon in Meteorites, Nature, vol. 251, pp. 21-24, 1974.

4. Elemental and Isotopic Inhomogenetics in Noble Gases: The Case for Local Synthesis of Chemical Elements, Transactions, Missouri Academy of Science, vol. 9, pp. 104-122, 1975.

5. Xenon Record of the Early Solar System, Nature, vol. 262, pp. 28-32, 1976.

6. Strange Xenon, Extinct Superheavy Elements, and the Solar Neutrino Puzzle, Science, vol. 195, pp. 208-210, 1977.

A copy of the reprint of these articles is attached (Appendix-1).

Some of this work apart from appearing in some newspapers has been also highlighted in magazines like Science News, Physics Today, Nature, etc. In a recent article by Grace Spruch in Physics Today (May 1977) the quote from Wasserburg describes the current excitement about the history of formation of our Solar System. He said, "The discovery of new isotopic effects, which are related to nuclear, chemical, and kinetic effects, is taking place very nearly on a weekly basis. Therefore anyone trying to play God is in a crap game with very rapidly changing rules." We feel fortunate for having pointed out as early as 1972 that carbonaceous chondrites contain a unique component of xenon (termed xenon-X) which is enriched in both light and heavy isotopes-a product of p and r process respectively. We suggested that the Xe-X in carbonaceous chondrites represents material that has been added to our Solar System from a nearby supernova.

In 1974 we noted that the sufficient quantities of xenon-X were present in the early Solar System to alter the isotopic composition of bulk xenon in region where meteorites trapped this element. Recently we have shown that solar type xenon also contains this component of xenon and the xenon-X was dominant in certain regions of our Solar System. It has also been noted that xenon-X is associated with high abundance of He and Ne and with an isotopically distinct component of Kr (termed Kr-X) and in the preprint attached (Appendix-II) we show that an anomalous component of Ar is also associated with the X-type krypton and xenon. It is also shown that the high abundances of He and Ne are always associated with X. The so called normal component of Ar, Kr and Xe in meteorites (Termed -Y component) contains none or negligible amount of trapped He and Ne. In addition to Type-X and Type-Y noble gas components, meteorites contain an additional component due to solar wind implanted gases (Type-S). The abundance and isotopic composition of trapped noble gases in all classes of meteorites can be understood in terms of a varying mixture these three types of noble gases. Due to metamorphism, mass dependent fractionation has further altered the abundance pattern and to some extent isotopic composition of noble gases in meteorites.

It has been noted that type-Y noble gases are dominant in the region of inner planets while type-X noble gases are dominant in the outer planets. Nucleosynthesis of X will occur in the outer envelop of a supernova while Y will be produced in the inner regions of a supernova. Variations in the occurence of Type-X and Type-Y noble gases are of such magnitude that neither the injection of material from a nearby supernova nor presence of presolar grains can account for the anomalies in meteorites. Therefore we have suggested that our entire solar system may have condensed from the

debris of a single local supernova. Supernova fragmentation model of Brown (ICARUS 15, 120, 1971) in which he tried to develop the formation of our Solar System with all its regularity from a single supernova, provides a natural fit to the complexities of our Solar System.

In the course of this investigation several undergraduate chemistry majors at Grambling State University worked on this project. They were exposed to methods of research and thus had a very useful learning experience.