Letters to the Editor

Comments on "The Nonlinear Dynamics of the Oklo Natural Reactor"

The conclusions in the paper by Bilanovic and Harms[1] concerning the supposedly chaotic dynamics of the Oklo phenomenon[2,3] should be reevaluated.

The authors base their simulation results on the behavior of a dynamic model of a boiling water reactor[4] (BWR). In particular, they use a predicted period of a BWR limit cycle (2.3 to 2.5 s) to infer parameters for their model of Oklo. It would appear, however, that the reactivity feedback mechanism in Oklo has very little in common with any simulation model of a BWR.

If the authors had constructed a hydrogeologic feedback model with reasonable parameters, and then demonstrated period-doubling bifurcations on the computer, they would have had an exciting result. Without that, their conclusions should be regarded as speculative.

David L. Hetrick

University of Arizona
Department of Nuclear and Energy Engineering
Tucson, Arizona 85721

March 19, 1986

REFERENCES

1. Z. BILANOVIC and A. A. HARMS, *Nucl. Sci. Eng.*, **91**, 286 (1985).

2. "Le Phenomene d'Oklo," *Proc. IAEA Int. Symp. Oklo Phenomenon*, Libreville, Gabon, June 23-27, 1975, CONF-750641, International Atomic Energy Agency (1975).

3. G. A. COWAN, *Sci. Am.*, **235**, *1*, 36 (July 1976).

4. J. MARCH-LEUBA, D. G. CACUCI, and R. B. PEREZ, *Nucl. Sci. Eng.*, **86**, 401 (1984).

Response to "Comments on 'The Nonlinear Dynamics of the Oklo Natural Reactor'"

We welcome David Hetrick's letter[1] and offer the following comments:

1. As we indicated,[2] the period 2.3 to 2.6 s was chosen because this yielded the burn duration of $\sim 10^6$ yr as estimated for Oklo by other methods (p. 291).

2. Our view of the commonality of the feedback mechanism between Oklo and a boiling water reactor extends only to the recognition that with increasing temperature, water will boil.

3. We share Hetrick's interest in a realistic hydrogeologic model of the Oklo environment but wonder how this can be achieved about an event that occurred ~2 billion yr ago and lasted about a million years.

4. Finally, Hetrick may be reading more into our conclusion than intended. In our closing paragraph we state that "... it *may have been possible* for the Oklo reactor, and other natural reactors, to operate in a totally random or chaotic fashion."

Archie A. Harms

McMaster University
Department of Engineering Physics
Hamilton, Ontario L8S 4M1

April 28, 1986

REFERENCES

1. D. L. HETRICK, *Nucl. Sci. Eng.*, **94**, 287 (1986).

2. Z. BILANOVIC and A. A. HARMS, *Nucl. Sci. Eng.*, **91**, 286 (1985).

Comments on "Application of Neutron Transport Green's Functions to the Calculation of Pressure Vessel Fluence"

Carew et al.[1] have recently derived a simple and accurate analytic method for calculating pressure vessel neutron damage >1-MeV fluence. The method employs a one-speed neutron transport Green's function, together with an effective removal cross section obtained by fitting transport flux results. The analytic method reproduces detailed two-dimensional numerical flux results within 5%.

The use of a Green's function or point kernel in such an application was reported earlier.[2-4] An irradiation exposure profile was calculated[2] for the reactor pressure vessel of the Portable Medium Power Plant (PM2A) and was compared with experimental measurements. Calculated values of ^{54}Mn activity and of exposure (time-integrated neutron flux >1 MeV) were given at three radial locations through the vessel wall at the maximum axial-azimuthal location. Comparisons of calculated and measured ^{54}Mn activity at the inner edge of the