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Historical interpretations of isotope measurements and applications

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The French PWR power reactors were using uranium enriched to about 3.5% in U235. Prior to enrichment, a routine check at Pierrelatte revealed abnormalities in U235/U238 isotope ratios. Such anomalies made UF6 inappropriate for enrichment, which was essential. An investigation requested by the General Manager of the CEA has made it possible to clarify the origin of the ore treated and the causes of these anomalies: chemical, nuclear or other? Interpretation of isotope measurements of various fission products (particularly Nd then Sm, Eu...) demonstrated the occurrence of sustained fissions in the extracted ore: once the small contribution of natural elements to this ore was deducted, the resulting isotopic vectors corresponded well to the isotopic vectors of the fission products. In the autumn of 1972, the use neutronics code to calculate the concentrations of 600 PF made it possible to better characterize the "operation"of these reactors: some reaction zones were indeed fast-breeder reactors, since the existence of Pu239 and "rapid fast neutron"fissions on U238 had occurred. The possibility of a critical state has been demonstrated with a simple reactor model. This possibility results from the combination of two particularities: a minimal presence of water with an enrichment in U235 of the order of 3.5% due to the age of formation of the uranium deposit (2Gy). Forty years after NAUDET's first Oklo ore criticality study, more complete studies of inception condition were carried out at the University of Strasbourg with realistic models, explaining the startup condition of these cores.
In 2010, Professor EL ALBANI highlighted the presence of fossils dating back to the same period and located in the vicinity of the reactors. This event was be the object of a bomb in the scientific world since the appearance of such an elaborate life form would have appeared only 0.6Gy before our era.
The joint occurrence of the two separately improbable phenomena (reactors and fossils) can only draw attention; this was the origin of the conference/debate organized in autumn 2018 by SFEN/PACA: "Chance hazard or causal relationship?".
In order to stimulate discussion with radiobiologists, we proposed, as a first step, to calculate the deposition of energy in matter over versus the ages. For this purpose, we use isotopic measurements made nowadays. The case of the Oklo reactors is the first application. The second case, the "La Crouzille"uranium mine, is complementary to the first in terms of the nuclear conditions (intensity and age of formation). The third case is the situation of a lagoon environment, looking for possible explanation of the start of Life on Earth. For all these cases we determine neutron spectra and concentrations of about 1800 isotopes (fissile with their progeny filiation products, fission and activation products). These concentration values can be used to discuss the storage of natural or non-natural radioactive waste.

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