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Influence of Initial poisons and clays on the criticality of Oklo natural nuclear reactors.

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In the aim to assess more the Oklo phenomenon through the numerical modelling and simulation, within the geological context based on field observations and measurements, a Python-based code is developed to automate the criticality research for a given configuration among a specific parameter, considered as the main variable of investigation. The home-made python program interacts with dedicated code for nuclear reactor criticality calculation, namely MCNP. This allowed us to investigate the asymptotical criticality occurrence, which corresponds to infinite multiplication factor k_∞ as a function of Uraninite fraction volume and total saturated porosity: k_∞ (V_UO2,Φc)≅ for different situation defined with relevant parameters, namely: Initial Poisons (Gd, Sm and Nd) and Clay fraction in the Gangue part of the U-rich ore. Indeed, in the first step of the present work, a generic U-rich ore was simulated over a given interval of Uraninite volume fraction and the corresponding porosities needed (Critical Porosity Φc) to reach criticality were obtained. It shows that an optimal point can be defined as the minimal one on the isocritical curve k_∞ (V_UO2,Φc)≅. This point, called "Inception point", is the most likely configuration to occur with low Uranium and less water defined by totally saturated porosity.

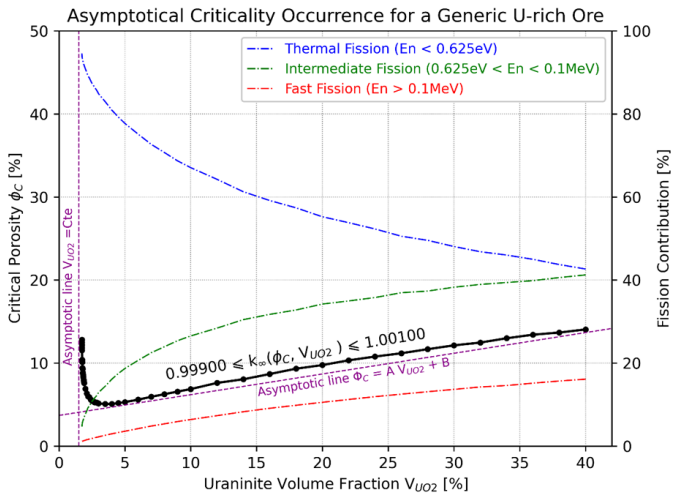

Figure 1. *Typical results of criticality research for a generic U-rich ore obtained with Python-based code with MCNP*

References

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