

## Talk Ok 2.5

Parallel between natural Oklo cores and industrial reactors operating

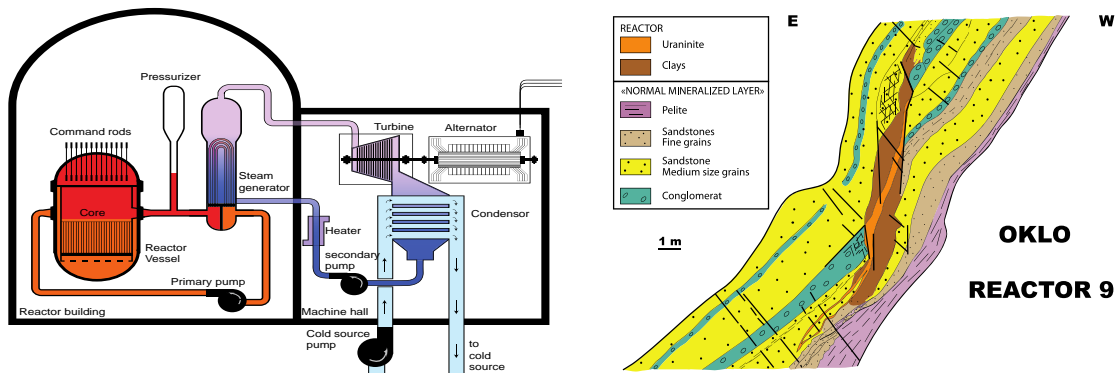
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The first man-made nuclear reactor was developed by Fermi at the University of Chicago and was first started in December 1942. This was the confirmation that one is able to use sustained fission reactions to produce energy. Following this success, the many types of nuclear reactors studied have given rise to several families of reactors corresponding to different orientations and technical choices. They are linked mainly to the choice of fuel (natural uranium, enriched uranium, plutonium), coolant (water, carbon dioxide, helium, sodium), fast or slow of neutrons and moderator for slow neutron reactors (graphite, light water, heavy water).

Out of all these choices the Pressurized Water Reactor (PWR) family is the closest to the Oklo natural reactors. Many intriguing similarities are observed and discussed in the present Supplementary Information C. Our present-day understanding of the PWR operating conditions has been a great help for understanding the Oklo reactors. On the other hand, the fast neutron reactors can also be put in parallel to Oklo cores since they did breed significant amount of plutonium-239 and since some zone are known to be operated as fast neutrons. The presentation will set a parallel between what Nature offered us with Oklo cores and the optimized cores we are able to build and operate.



**Figure 1 | Illustration of PWR circuits and Oklo core.** The primary circuit is a forced heat conduction loop. The 155 bar pressure is regulated by the pressurizer and prevents water from boiling in primary circuit. The secondary circuit is a water/vapour circuit with a pressure at full power of 71 bar. Steam is produced in the steam generator runs the turbine/alternator before being again transformed into liquid water in the condenser. Approximately one-third of the thermal power is transformed into electrical power and the other two-thirds is exhausted to the cold source (river or refrigerating tower). The Oklo core (figure from [1]) was 2000 m below surface with rather similar pressure and temperature as the PWR reactors !

### References

[1] Bentrudi, S.-E. & al., 2011. Inception and evolution of Oklo natural nuclear reactors. *Comptes Rendus Geoscience* 343, 738–748