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## NUCLEAR-MEDICAL TECHNIQUES IN 4IR DIAMOND MINING

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Kimberlite rock has been activated with a high energy photon beam, following which high energy resolution spectra have been acquired in time differential mode. This enables a lifetime analysis of the isotopes that have been activated. An isotope identification is then performed using the dual information of characteristic gamma rays and lifetimes. This enables an unambiguous assignment of the isotope identification. The results have been made quantitative by the Monte Carlo modelling of the activation process to extract the product of the effective radiation field and integrate this over the energy dependence of the cross-section. The results are compared to the known composition of kimberlite as follows: The time differential activation code, FISPACT, is used to perform a pathway analysis to establish the various activation pathways, given the mixed radiation field and the ENDF / TENDL cross sections for the various nuclear reactions. The pathway analysis is then used to attribute the measured activity to specific parent isotope composition, and hence to the elemental analysis of the kimberlite. The experimental work was performed using the Aarhus 100 MeV electron microtron. The results have two roles. In the first place, they establish the radiological significance of the activation process of the MinPET method in sorting diamondiferous from barren kimberlite rock. In the second place, this is an interesting analysis technique capable of nuclear analysis of light elements (carbon and oxygen) and also differentiating various PET isotopes.

### **Apply to be considered for a student ; award (Yes / No)?**

Yes

### **Level for award;(Hons, MSc, PhD, N/A)?**

MPhil

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