

DATING OF BRAZILIAN SOUTHERN MEGAFUNA BY ESR SPECTROSCOPY

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The study of paramagnetic defects in biomaterials, such as bone and teeth, found in archaeological sites can lead to the determination of the age. Electron Spin Resonance (ESR) spectroscopy is used to determine the concentration of these paramagnetic centers created by radiation from the surrounding sediment and cosmic rays and the accumulated dose. Using appropriate models the age of the sample can be determined. Tooth enamel is ubiquitous at many archaeological sites and is well suited for ESR dating, with a precision of about 10% on the age estimation. This method was used in order to date eleven teeth samples of different species such as *Toxodon*, *Stegomastodon* and *Hippidion* from Brazilian southern megafauna. The dating of these samples can contribute to the better knowledge of megafauna presence in this region as well as to the events associated to the extinction of these species. In some cases ESR is an interesting possibility of dating, since no remains of compounds containing C-14 can be found.

Before the ESR measurements, the enamel samples were mechanically and chemically treated in order to separate dentin from enamel. The enamel was powdered in fine particles (diameter $\phi < 0.5\text{mm}$), etched in acid solution to remove the external layer ($\sim 500\ \mu\text{m}$) and the possible contribution of external alpha irradiation and divided in aliquots of about 100 mg for laboratory additive irradiation. A dose up to 3.2 KGy was given to samples. ESR spectrum was recorded in a Varian E-4 Spectrometer system, operating at X Band ($\nu \sim 9\ \text{GHz}$), with modulation amplitude of 0.2 mT, scan range of 10 mT, scan time 1 minute and adequate microwave power.

The additive dose method was used to plot the dose-response curve and an archaeological dose (AD), was found by using a linear or exponential fitting, depending of each case [1]. The total annual dose rate and the sample age were calculated by using the ROSY software [2]. Using the concentrations of Uranium-238, Thorium-232 and Potassium-40 that were found by neutron activation analysis technique, as well as the cosmic rays rate. In order to calculate the ages, the combination uptake model was taken. A wide range of dates from $(18 \pm 3)\ \text{ka}$ to $(737 \pm 36)\ \text{ka}$ was found implying that a possible occurrence of reworking of these fossil sites, that has also been found in other sites [3]. This information together with other data can allow a better understanding of the events regarding the extinction of megafauna and show the importance of ESR as a dating technique.

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References:

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