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SOME ESR STUDIES OF THE RESPONSE TO γ -RAY DOSES OF
STALAGMITIC CALCITES

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Speleothem calcites from various caves in France and Brazil, with formation ages from present to about 5×10^5 yr were exposed as sieved powders to various doses of γ -rays. The measurements were made in X band at room temperature on samples with or without a chemical treatment aimed at eliminating tribo-effects.

In all samples, ESR absorption lines appeared at or near g values of $g_1 = 2.0064$, $g_2 = 2.0032$ and $g_3 = 2.0007$, when observed at a range of 100G, i.e. in those regions of the spectrum dubbed h_1 , h_2 and h_3 by Yokoyama et al. (1981). In very young samples, the intensities of the h_2 and h_3 lines were found to grow non-linearly with γ -ray doses between 5 krad and 80 krad. Meanwhile, the h_1 line was found to saturate at a lower dose, of the order of 20 krad.

When ESR spectrum were taken at range of 20G with a modulation of 0.1G, the h_2 and h_3 lines revealed composite, with components belonging to CO_3^{--} and CO_2 species (see companion abstract).

Samples which were not chemically treated after crushing and sieving exhibit one more line at $g = 2.0000$. This line, which is isotropic and saturates at a low klystron power ($\approx 5\text{mW}$) also increases with dose. Its intensity, for a given dose, varies inversely with grain size. As in addition, it was never observed in monocrystals. It is inferred that this line results from artefacts introduced during sample preparation (surface defects).

Isothermal treatment at 180°C shows that while after 3 hours heating, the intensity of h_2 and h_3 lines (as measured with 100G range as often used in ESR dating) is drastically reduced. The h_1 line starts to increase only after 6 hours which is in contradiction with the direct redistribution of h_2 and h_3 upon h_1 as earlier observed by others.

The recognition of the complex structure of h_2 and h_3 , thermal behaviour of these and h_1 lines as well as eventual presence of an artefact line in the h_3 region have consequences on ESR dating procedures, in particular relatively to the experimental determination of the "Total Irradiation Dose" to which the samples were naturally exposed.