

## Quartz natural and laboratory ESR dose response curves: A first attempt from Chinese loess

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The natural electron spin resonance (ESR) dose response curve (DRC) of the Al and Ti centres was constructed for the first time using sand-sized quartz samples from Luochuan, Chinese Loess Plateau, to investigate the upper limit of quartz ESR dating. The natural DRC of both centres showed an unexpected early saturation, with characteristic saturation dose ( $D_0$ ) values of 770 Gy for the Al centre and 650 Gy for the Ti centre. This corresponds to the upper age limit of ~500 ka (Al centre) and ~400 ka (Ti centre), using the mean dose rate of 3 Gy/ka. The regenerated laboratory DRC of both centres showed much higher saturation dose, but both the intensity and  $D_0$  value of the regenerated ESR signals decreased significantly with increasing preheat temperatures. The natural DRC had a better match with the laboratory DRC following higher temperature preheats, ~210-240°C for 4 minutes, clearly indicating the need for preheating after laboratory irradiation for quartz ESR dating. The results of isothermal heating tests revealed that the thermal lifetime at 10°C at the studied site was  $1.5 \times 10^9$  and  $1.7 \times 10^6$  years for the Al and Ti centres respectively. The relatively short thermal lifetime of the Ti centre may explain the early saturation of the natural Ti DRC. The thermal stability of ESR signals plays an important role in controlling the maximum dating range of ESR.

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