Intra-laboratory comparison of different experimental setups: another step further in the standardization of the ESR dating method applied to quartz grains

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Electron Spin Resonance (ESR) dating is a powerful method with a wide range of applications in Geosciences and in Archaeology. However, compared to other more established numerical dating methods such as Radiocarbon, Uranium-series, Ar-Ar or Luminescence dating, ESR suffers from a lack of standardization among the different laboratories around the world, not only in the analytical procedures employed, but also in the reporting of dating results and methodology. This is undoubtedly a major limiting factor for the development and wide recognition of the ESR dating method within the scientific community.

A few decades ago, some major inter-laboratory comparison studies have been focused on ESR dating of calcite or corals. In contrast, such attempts have never been reported so far in the case of ESR dating applied to optically bleached quartz grains since the first dating study published by Yokoyama et al. [1], while the repeatability of the ESR measurements of Al- and Ti-centres performed at low temperature (<100 K) is significantly more challenging.

In the recent years, part of our investigation has been centred on improving the reliability and accuracy of the ESR method applied to quartz grains, by identifying some of the main sources of uncertainty in the dating process. For example, a special attention has been paid to the selection of the correct fitting functions and to the evaluation of the impact of temperature on ESR intensity measurements and repeatability [2,3]. More recently, the definition of some minimum requirements for reporting ESR dating results and methodology based on quartz grains dating has also been proposed [4].

In the line of this ongoing investigation, we evaluate here the impact of the experimental setup on the ESR measurements and dose evaluation. Repeated measurements of quartz samples were performed at CENIEH, Spain, using two different Bruker spectrometers (EMXmicro and Elexsys E500) and resonators (standard rectangular ER 4102ST and cylindrical Super High QE cavities). Their performance in terms of sensibility, measurement repeatability and dose determination is presented here. The results of this work will enable to evaluate the potential impact of different experimental setups (as it is almost always the case among different ESR dating laboratories) on the dose evaluation, which is essential for a future standardization of the ESR dating method applied to optically bleached quartz grains.

References

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