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Performance of SAR-SGC method for equivalent dose determination of quartz OSL

Xiaojun Zhou, Yuexin Liu, Xinqi Feng, and Zhongping Lai
Shantou University, Institute of Marine Sciences, Guangdong Provincial Key Laboratory of Marine Disaster Prediction and Prevention, Shantou, China

Abstract: The SAR-SGC method, integrating single aliquot regenerative (SAR) and standardised growth curve (SGC) protocols with advantages of saving machine measurement time. It has gained widespread application in recent years over diverse sediment types, including glacial, aeolian, fluvial, lacustrine, deltaic, and marine sediments. The method constructs inter-aliquot SGCs using conventional SAR measurements and determines SGC D_es by inserting the L_N/T_N values of additional aliquots into the SGC. The final SAR-SGC De is obtained by calculating the arithmetic mean of the SAR D_es and SGC D_es. However, the optimal number of SAR and SGC aliquots for reducing machine time while retaining precision, is still ambiguous. To address this issue, we systematically investigated how varying the number of SAR aliquots and additional L_N/T_N measurements influences the stability and consistency of equivalent dose derived from SAR-SGC method with SAR protocol. We examined the minimal SAR-SGC combinations for three samples (JNZK01-G09, MW10-G16 and XBG06-G07, with an equivalent dose of ~44 Gy (with largest scatter in inter-aliquot SAR growth curves), ~46Gy and ~55Gy (with marginal scatter in inter-aliquot SAR growth curves) in the lower Yellow River plain, utilizing a Risø TL/OSL-DA-20 reader with a 90Sr/90Y beta source. Through extensive statistical evaluations, SAR-SGC estimation of the equivalent dose obtained with differing aliquot combinations shows that equivalent dose could be accurately estimated within acceptable uncertainty (<10%) using 6–15 SAR aliquots and additional 12–30 L_N/T_N aliquots. For samples with dispersed growth curves, we recommend a minimum of 6 SAR and 12 L_N/T_N aliquots for reliable age determination. And samples with concentrated growth curves may suffice with 4 SAR and 10 L_N/T_N aliquots. This study demonstrates that the combined SAR-SGC method significantly reduces machine time (at least 70%) compared to the SAR protocol alone while maintaining acceptable precision. These findings provide valuable guidance for luminescence dating laboratories and researchers in optimizing instrument usage under time constraints.

Key words: SAR-SGC method; Standardized growth curve; Single aliquot regenerative protocol; Equivalent dose; Luminescence dating; Statistical analysis; Machine time optimization