

ESR dating of quartz: issues on sediment dating and on thermochronometry

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Electron spin resonance (ESR) detects unpaired electrons in materials. The principle of ESR dating is the same as luminescence dating that the “signals” (unpaired electrons in ESR) created by natural radiation are accumulated with geological time scale. As quartz is one of the minerals most abundant on the surface of the earth, there are many applications using quartz ESR signals, such as fault movements, tephra, sediments, and heating of flints. Another advantage of using quartz is that it has several paramagnetic centers (ESR signals such as Al, Ti-Li and Ti-H centers) to be used for dating so that “multiple center” approach is possible where ages can be obtained with several signals independently to check the reliability.

One of the most important issues of ESR dating of quartz is how to be sure that the signal has been completely erased at the time of dating events. Among the above materials, tephra would most surely be zeroed at the time of the dating event, which is volcanic eruption. However, ESR dating of tephra would still be the subject of methodological investigation where Toyoda et al. (2006) showed that the problem is determination of D_E .

Probably, fundamentals on ESR dating of quartz should be again investigated where the key issues would be the dose recovery and preheating. It is possible that paramagnetic defects in quartz exchange electrons and holes with thermal activation processes that would modify the original amount of the signals formed just by radiation. Possible sample and age range dependence should be a factor that makes things more complicated. The protocols developed for luminescence dating should be adopted to establish the method of ESR dating of quartz.

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