

This work focuses on the bivalve *Glycymeris*, commonly used in classic amino acid racemisation (AAR) studies in the Mediterranean, as part of an extensive assessment of the suitability of intra-crystalline protein diagenesis (IcPD) dating. We test the closed system behaviour (a prerequisite for IcPD studies) of *Glycymeris* through bleaching and heating studies, as well as fossil material sourced from Last Interglacial deposits in Sardinia (Calamosca), Mallorca (Palma Bay) and Tunisia (Hergla). Although bleaching appears to be effective in isolating an intra-crystalline fraction of proteins, this fraction may not behave as a closed system in all molluscan taxa, as we verify here for some of the fossil *Glycymeris*. We show that open-system behaviour can be identified by analysing the covariance between FAA and THAA fractions and the relative THAA composition and we also provide further evidence that, for taphonomic reasons, dating the molluscan fauna does not necessarily yield age information for the sedimentary units when these contain derived shells.