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Astronomical calibration of geological time

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Orbital tuning of climate proxy records to astronomical target curves provides a fully acceptable alternative method for absolute age calibration of geological time that is totally independent of radio-isotopic dating. Starting with the CLIMAP and SPECMAP projects in the seventies and eighties, astronomical tuning of deep-marine continuous successions combined with integrated high-resolution stratigraphy underlies the - age calibration of the - new standard geological time scale for the Neogene and this tuning is now being extended into the Mesozoic. Tuning of Paleogene and Cretaceous sections including ODP holes is greatly facilitated by the recent publication of full numerical solutions for the Solar System and the presence of a very stable 400-kyr component in eccentricity as prime target. The progress recently made in astronomical dating asks for a unified codification scheme, the designation of unit stratotypes for global stages and the introduction of astronomically defined chronozones as formal chronostratigraphic units.

In this way a new generation of geological time scales with an unprecedented accuracy and resolution is being generated that is not prone to a promulgation of new time scales. Such an accurate high-resolution time scale is of prime importance not only for understanding astronomical climate forcing but also for unravelling numerous fundamental problems in Earth Sciences such as the origin of 3^{rd} order sequences and the ongoing debate about the tectonic versus climate control on the Messinian salinity crisis in the Mediterranean. In addition the new time scale will help solving fundamental astronomical issues such as the degree of chaotic behaviour of the Solar System.

Of great importance is the intercalibration of astronomical and $^{40}Ar/^{39}Ar$ time by single crystal sanidine dating of primary ash layers in astronomically dated sections. Based on data from the Melilla Basin, the intercalibration arrives at an astronomically

calibrated age of 28.24 $\pm$ 0.01 Ma for the FCT sanidine dating standard. The error is very small because the uncertainties in the decay constants and the dating standards have been largely eliminated. Consequences of the intercalibration for the ages of major geological happenings such as at the P/E and K/T boundaries will be discussed, also in the light of the ongoing tuning efforts.