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A New Technique for Quantification of Water Depth Applied to the Demise of a Carbonate Platform

This study illustrates a new technique for reconstructing paleowater-depth using fluid inclusions in submarine cements. It is applied to a Jurassic carbonate platform, Monte Kumeta (Sicily), which experienced termination in benthic sediment production, followed by unconformity and pelagic sedimentation.

Analyses were performed on overgrowth cements in crinoidal limestones, which formed during the transition to platform termination. There are three major growth zones. Zone 1 contains fluid inclusions with distributions indicating entrapment during growth and early recrystallization. Zones 2 and 3 contain fluid inclusions trapped during growth. Cements contain all-liquid inclusions, indicating low temperature of entrapment, and yield Tm ice of approximately -1.98C, indicating seawater salinity. Some inclusions contain large bubbles suggesting entrapment of seawater and gas. In these, bubble volumes were measured and inclusions were opened while immersed in glycerine. Comparing the bubble volume before opening to that after opening yielded the pressure in the inclusion. Because inclusions were trapped at low temperature, this pressure is the pressure of entrapment on the Jurassic seafloor, a proxy for water depth. From 31 analyses, pressures range from 3.3 to 12.2 atmospheres, indicating water depths of 23 to 112m.

These data show that cementation of the crinoidal limestones started at water depths of about 23m. Thus, crinoidal deposition and platform termination began in water depths shallower than 23m. With the biostratigraphic constraints available, the maximum rate of relative sea-level rise was just 12 m/m.y. These data suggest that platform termination began in relatively shallow water during slow rates of relative sea-level rise.