Gypsum Cements in Cenozoic Sediments in the Murray Basin, South Australia: their Age and Origin

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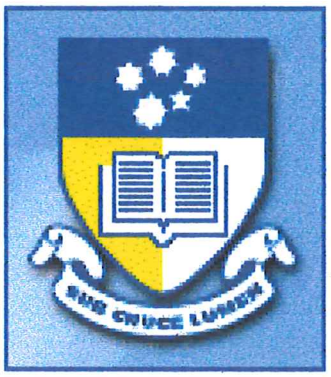

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I would like to dedicate this thesis to the memory of the Late Plio-Pleistocene megalake, Lake Bungunnia. Less we forget many wonderful days we spent together, looking across the Marimon Jabuk Range from the uplifted Pinnaroo Block.

ABSTRACT

A maximum Pleistocene (~0.6 Ma) age has been assigned to surface and sub-surface gypsum cements occurring in the Norwest Bend Formation and Upper Morgan Limestone, in the western Murray Basin. The gypsum cements post date the draining of Lake Bungunnia and the formation of the Murray River Gorge. The chemical and morphological diversity exhibited by the gypsum forms indicates a variety of genetic processes. Three main gypsum facies can be distinguished by their structural fabrics, which are indicative of the environmental conditions in which they formed. (1) Bedded gypsum crusts (selenite) and gypsum nodules have fibrous to lenticular crystals and occur as discrete horizons along sections of the Murray River cliffs. (2) Massive crystalline gypsum contain piokilitic inclusions of clastic material, indicating they formed below the surface where long periods of stable brine conditions allowed for large crystal growth. (3) Aeolian seed gypsum dunes derived from the deflation of gypsum from modern playa lakes. (4) Gypsum crusts

Sulphur and Strontium isotopes, fluid inclusion studies, and geochemical analysis (XRD) and (XRF), were used to interpret the brine conditions under which the different gypsum facies formed. Fluid inclusion analysis was used to determine the palaeosalinity of the brines from which the gypsum precipitated. The melting temperatures of ice in fluid inclusions indicate that brine salinities and compositions were similar to brines derived from evaporated sea water. They also indicate that gypsum crusts formed from less saline water than selenite and gypsum nodules. The $\delta^{34}S$ ratios of gypsum crusts are also close to seawater values (+17.9‰ to +20.2‰ CDT), indicating marine sulphate is the dominant source of sulphur. Strontium isotope data negate the possibility of derivation of the lacustrine "seawater like" brine chemistry, from either marine transgressions or weathering of connate salts from marine strata alone.

Sulphur and Sr isotope ratios of the gypsum crusts indicate that gypsum was predominantly derived from the dissolution of the aeolian gypsum dunes by meteoric water influenced by sea spray. The demise of Lake Bungunnia indicated the onset of aridity in Southern Australia. The draining of the megalake may be responsible for the gypsum cements and the aeolian gypsum dunes from which they were derived.