

Karst Hydrogeology and Speleogenesis in the Leeuwin-Naturaliste Ridge

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ABSTRACT

Southwestern Australia holds extensive karst developed in coastal Quaternary dune limestones. Thermoluminescence dating and altitudinal correlation with palaeo shorelines suggest an early Pleistocene or Late Pliocene age for the oldest dune units. Syngenetic karst development has proceeded with lithification of the dune ridges. In the Leeuwin-Naturaliste Ridge, the dune limestones are underlain by an impermeable granite basement which has strongly influenced the karst hydrology and speleogenesis. A diversity of karst drainage systems and associated cave patterns are represented, including: (1) Exsurgences or stream caves dominated by diffuse autogenic recharge; (2) Directed conduit caves fed by allogenic winter-flowing streams sinking at the inland margin of the dune ridge and which drain rapidly beneath the ridge to resurge on the coast; (3) Watertable maze caves developed by mixing corrosion processes and involving allogenic swamp waters in a flank margin setting. The geomorphic history of these swamp margin caves involved multiple cycles of fluctuating watertable levels linked with climate change and extreme flood events over the last > 600, 000 years, whilst marine waters may also have influenced speleogenesis during sea level highstands.

Environmental Hydrology and Stygofauna in the Jewel Cave Karst System

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ABSTRACT

The Jewel Cave karst system comprises extensive watertable maze caves developed within a shallow aquifer in coastal Quaternary dune limestone, southwestern Australia. The groundwater ecosystem includes communities of freshwater invertebrates associated with submerged tree roots. These aquatic root mat communities are listed as critically endangered due to declining groundwater levels, which have dropped > 1 m during the previous 22 years. Southwestern Australia is a region notable for a prolonged and significant decrease (21 %) in winter rainfall over the period since 1968, although rainfall in the study area decreased only 1 % over the same period. Groundwater pumping and tree plantations have not contributed to the watertable decline as earlier implied. Mean groundwater recharge rates decreased 29 % after 1979-80, corresponding with a significant change in fire regime within the karst catchment. Fire frequency decreased from an average 4.3 fires per decade to less than 0.5 fires per decade. The virtual absence of fire during the previous 25 years has allowed a dense growth of understorey vegetation and accumulation of ground litter, which through interception and evapotranspiration of rainfall, is hypothesised to be a major contributing factor to the watertable decline. A prescribed burn will be undertaken and the effects of fire treatment on groundwater recharge will be investigated with Before-After-Control-Impact (BACI) monitoring of rainfall, leaf area index, ground fuel load, soil moisture, infiltration rates and watertable response. The ecological requirements and conservation status of the groundwater communities are reviewed, and management strategies suggested.