

SEDIMENT BUDGET FOR THE GARDNERS GUT CAVE, WAITOMO

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ABSTRACT

Rates of cave fluvial sediment transport was examined in Gardners Gut cave (altitude 70-150m) in Waitomo, New Zealand. The cave receives a mixture of allogenic and autogenic sediment inputs. Allogenic material includes volcanic ashes and local siltstones.

A rated weir was constructed at the resurgence of the cave stream. Conductivity was monitored every 30 minutes as a proxy for dissolved load and multiple regression analysis was completed for the main solutes. The concentration of suspended material was monitored using an optical backscatter sensor every 30 minutes as a proxy for suspended load.

Bed material movement was monitored using randomly-chosen sediment particles 'tagged' with magnets and periodically rediscovered. Bed material accumulation in the weir pool was also monitored. Similar rates of bed material movement were observed using the two methods.

From 1998-2000, the cave stream had an average annual sediment yield of approximately 1415 t a⁻¹, comprising 71 t a⁻¹ bed material, 829 t a⁻¹ suspended material and 515 t a⁻¹ dissolved material, of which 365 t a⁻¹ is limestone. This is equivalent to approximately 340 m³ of allogenic sediment (not including dissolved load) and 53.1 m³ of limestone (assuming a density of 2.65 t m⁻³). The bedload is equivalent to roughly 0.2% per annum of the total volume of bed material in the cave.

Solutional denudation is calculated as 41.3 m³ km⁻² a⁻¹, which compares with a previous estimate of 69 m³ km⁻² a⁻¹ made for two autogenic drainage basins at an altitude of 360m, 8km further west. Annual rainfall at the higher site is 2366 mm a⁻¹, compared to 1630 mm a⁻¹ at Gardners Gut.

However, effective rainfall (rainfall minus evaporation and transpiration) is more closely related to solution denudation rates. The decline in effective rainfall of 35% between the two sites is associated with a decline in solution denudation rates of 40%.

Significant relationships exist between a seasonal rainfall index at Waitomo and the seasonal Southern Oscillation Index in winter and spring. This suggests changing climate conditions may influence comparisons between previous studies and the present study.

Suspended sediment load derives partly from the bed of the cave stream and partly from dolines that drain to the cave. Road works and vegetation clearances have previously significantly disturbed the catchment close to cave entrances.

Previous observations of larger quantities of fine-grained sediment in the cave suggest retirement of pasture and tree planting is reducing erosion in the cave catchment.