THE WAITOMO STREAM, WAITOMO GLOW-WORM CAVE, NEW ZEALAND

DAVID HAWKE*

Abstract

The Waitomo Stream, draining a catchment of approximately 45 square km, flows through the Waitomo Glow-worm Cave. A rapid increase in the rate of sediment deposition in the cave has been noted in recent years, threatening both the cave and the unique faunal assemblage. Ongoing research is aimed at quantifying the erosional and depositional aspects of the stream flow so that conservation measures may be established. This paper will describe the current programme, and present preliminary results.

Introduction

New Zealand's Waitomo karst has long been a focus of speleological and tourist interest, and its caves have deteriorated as a result. Recently, a growing awareness of the problems being experienced in the tourist caves has occurred, and a preliminary conservation study of these caves was initiated by the New Zealand Speleological Society (NZSS) in 1974-75. The results of this study (Williams 1975) indicated a need for further research in three main fields: glow-worm ecology, the growth and influence of Lampenflora, and the hydrology and sedimentation of the Waitomo Stream. The Tourist Hotel Corporation, which administers the tourist caves, has made funds available for graduate study of these topics, and this paper describes work being undertaken regarding the hydrology and sedimentation of the Waitomo Stream.

The Area

The Waitomo Stream drains an area of approximately 43 km^2 upstream of the Glow-worm Cave, and flows through the cave before reaching the Lower Waitomo Valley (Fig. 1). The basin's maximum relief is 400 m, and a number of component sub-basins may readily be distinguished. Oligocene crystalline bio-clastic limestones crop out over approximately 40% of the area, and are characterised by dense polygonal doline networks. Multi-level phreatic and vadose caves are common, and the streams which frequently occupy the lowest levels are an important component of the drainage network. The remaining 60% of the catchment is dominated by the surface exposure of younger sandstones and siltstones, with rare remnants of recent ignimbrite capping the hills. Volcanic ash mantles the catchment, and probably contributes much of the finer material carried by the streams.

The lithology is disrupted by a number of major faults, resulting in a stepped repetition of stratigraphy (Fig. 2). This repetition has a marked effect on the drainage system, since the streams are typically underground on limestone, and sub-aerial over the remainder of the basin. The underground portions are characteristically free air surface streams, although numerous sumped sections occur; that of the Glow-worm Cave (Fig. 3) being of particular significance due to its influence on the stream's hydraulic characteristics.

The Problem

The results of the preliminary study by NZSS indicated a rapid rate of sedimentation and hence stream floor build-up in the Glow-worm Cave. The current sedimentation rate was estimated as 57 mm per annum, approximately 4 m of sediment having been deposited in the last 50 years, and it was suggested that the submergence air space may be lost within the next 50 years if deposition continues at this rate. The present project aims to examine the sedimentation occurring in the Glow-worm Cave, having particular regard to its dynamics, mechanisms and sources. Hence it is concerned with establishing a sediment 'budget' for the catchment, and with the hydraulic factors which influence sediment transport and deposition. Since sediment transport is intimately linked

* Dept. of Geography, The University of Auckland, P.B., Auckland, N.Z.

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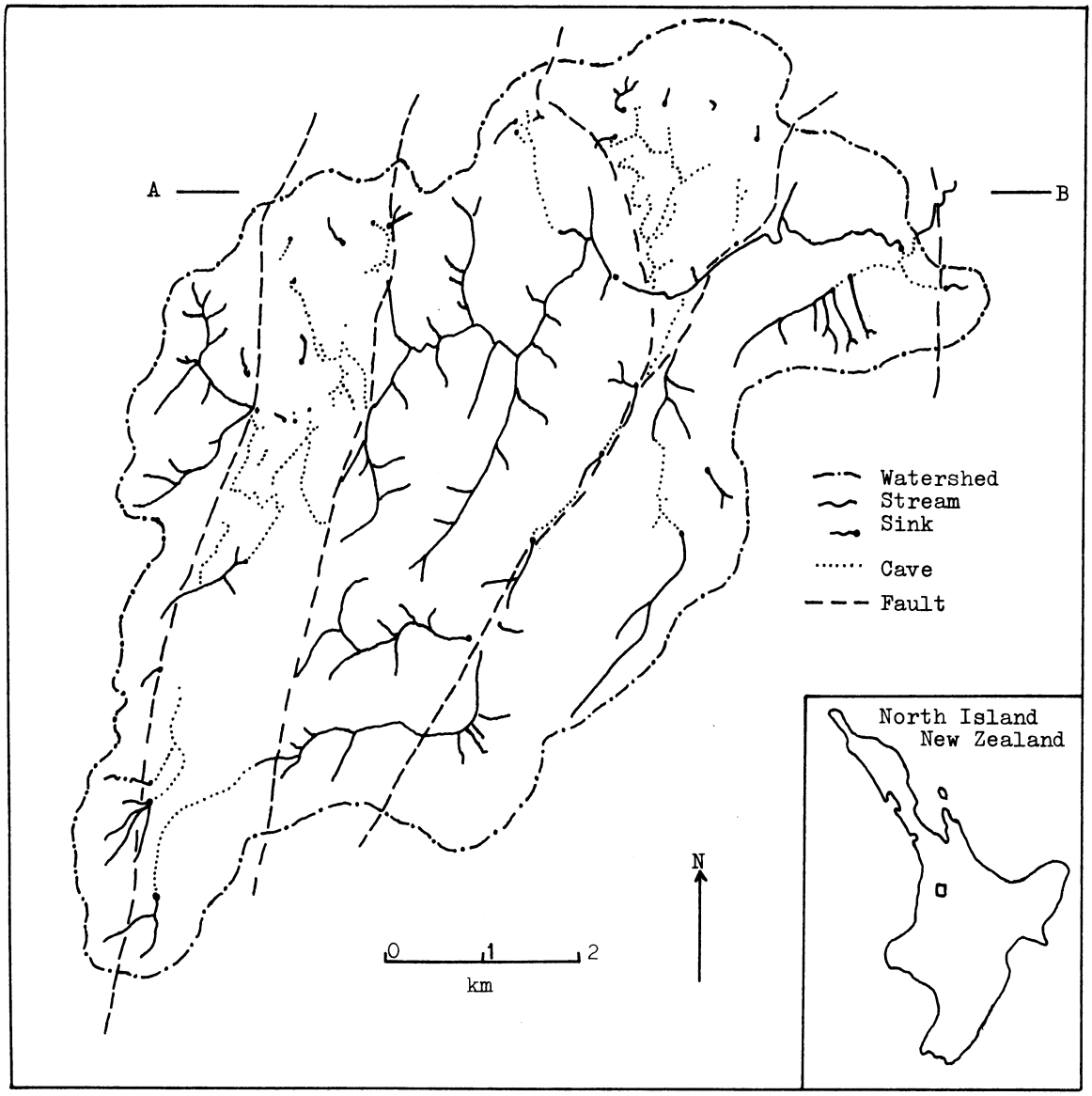

Fig. 1. The Waitomo Drainage Basin (after Kermode 1975).

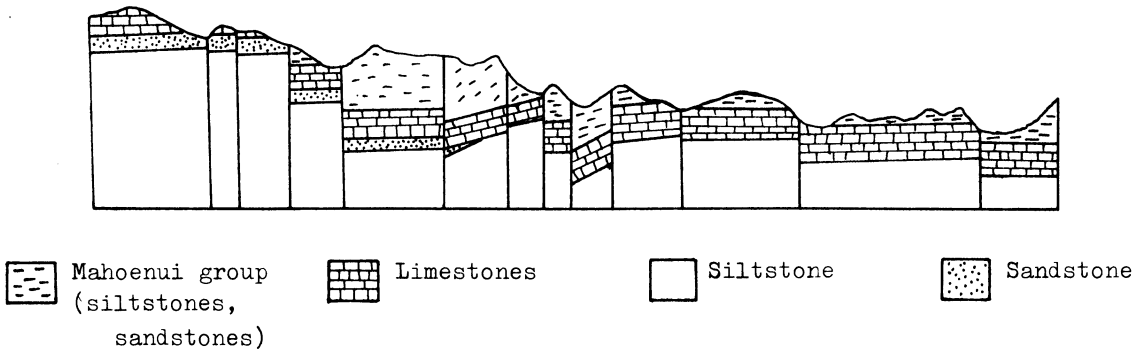

Fig. 2. Simplified geologic cross section (after Kermode 1975).

with the hydrological characteristics of the system, the hydrology of the Waitomo basin must also be examined, with particular attention being paid to the separation of karst and non-karst influences.

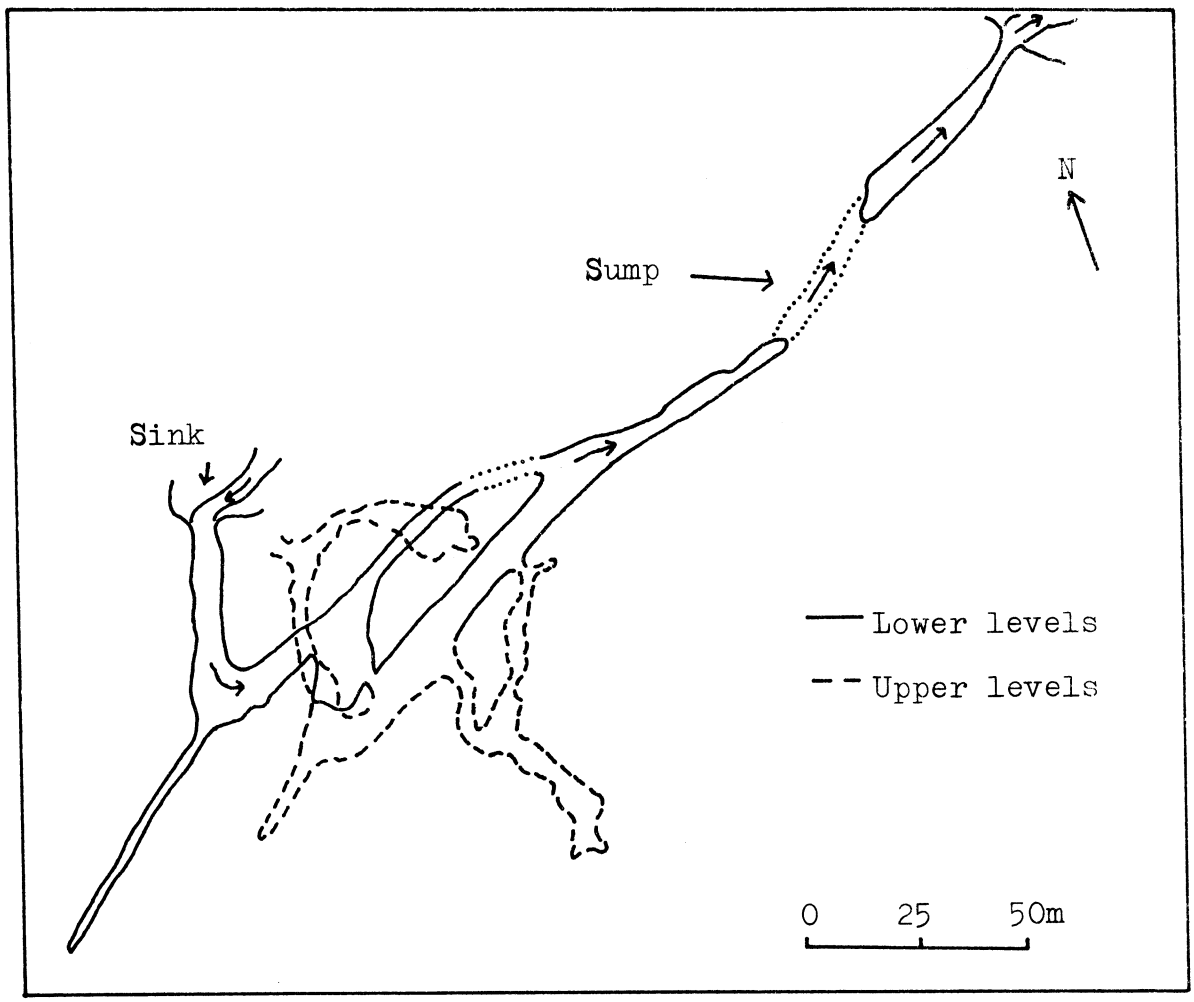

Fig. 3. The Glow-worm cave, Waitomo.

Research program and preliminary results

The data collection program has only recently been initiated, and is concentrated on the temporal and spatial variations in water and sediment discharge within the system, monitoring being conducted on an event rather than a regular basis. To enable the establishment of a sediment 'budget' for the system, a number of sampling points have been established (Fig. 1) where discharge measurements and sediment samples are taken. Stage-discharge and stage-sediment yield rating curves will be established for each site to enable comparison to be made between sites. The temporal variation of parameters will be established by correlating stage readings for each site with those of a master site where a continuous water level recorder is being maintained. Other characteristics of the study relate to the physical properties of the sediment, in particular the variation of bed material size throughout the catchment, and to the rate of transport of particular size fractions. The Glow-worm Cave is the subject of further attention regarding the changes in hydraulic parameters through the cave, and their influence on deposition.

Little data is as yet available on the operation of the system. Preliminary observations indicate that the system responds rapidly to rainfall inputs, and that the main sources of sediment are likely

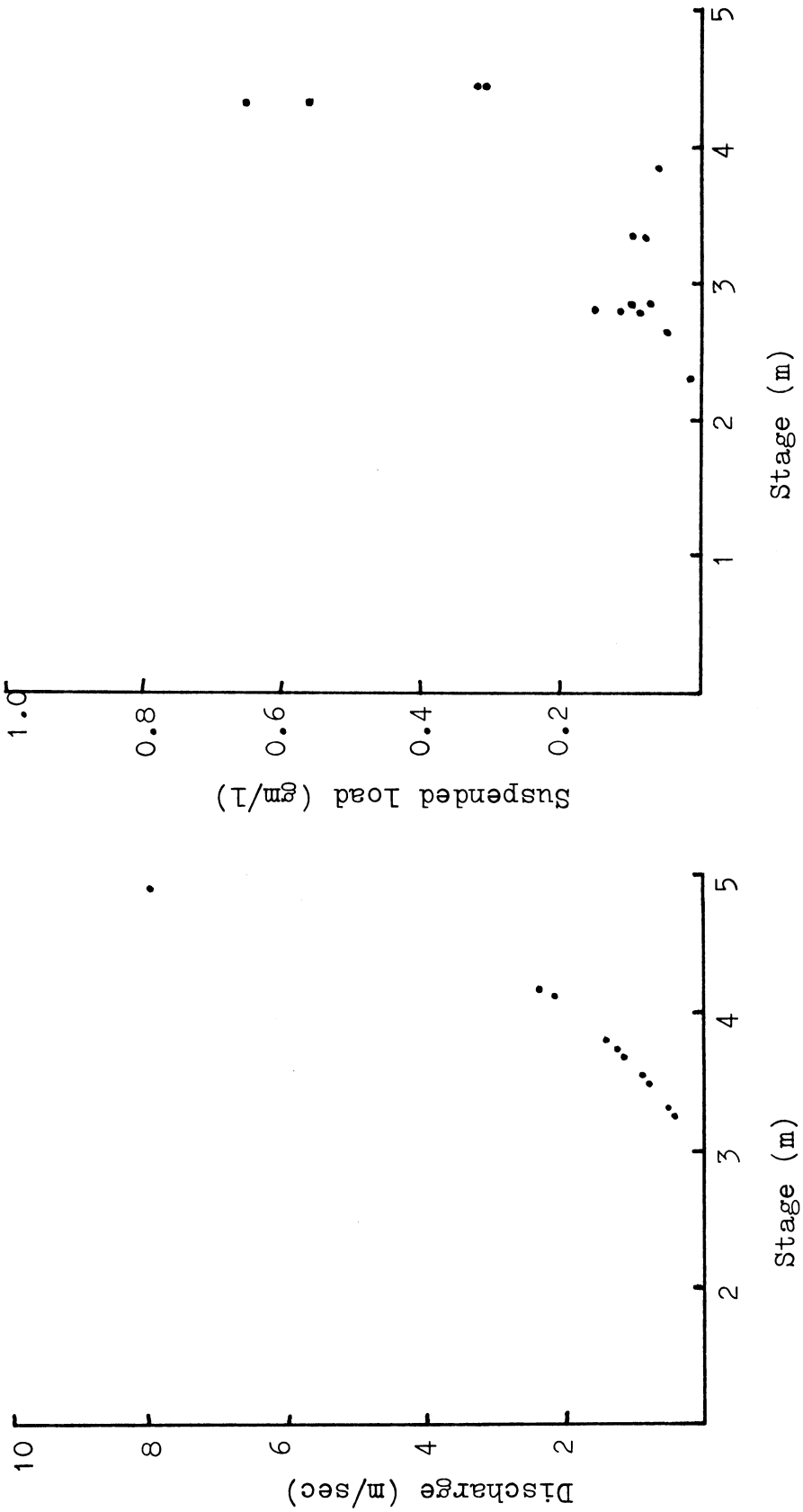

Fig. 4. Stage-discharge relationship, Waitomo master site.

Fig. 5. Stage-suspended sediment load relationship, Waitomo master site.

to be bank scour and erosion, and major road works located at the head of one tributary. Quantitative observations have thus far been mainly confined to the master site, and a preliminary stage-discharge rating curve has been established for this site (Fig. 4). The discharge of the system varies between 0.5 $m^3 s^{-1}$ at low flow and an estimated 15-18 $m^3 s^{-1}$ in high flow conditions, and there is a seasonal variation in baseflow discharge (0.5 $m^3 s^{-1}$ in summer, 1.5-2$m^3 s^{-1}$ in winter).

Suspended sediment concentrations in the system are generally low, the highest so far recorded being 840 mg per litre at 10 $m^3 s^{-1}$. It is notable that a great scatter of points occurs on the state-suspended sediment plot (Fig. 5), indicating that the sediment load may not be related directly to discharge, but may be influenced by factors such as season, antecedent conditions, limb of the hydrograph and source, particularly if bank collapse is dominant. Preliminary observations in the Glow-worm Cave indicate the need for concentration on that section of the system since as much as 50% of the suspended load may be deposited in the cave at moderate flows (2-4 $m^3 s^{-1}$).

Conclusion

The work thus far has indicated a number of avenues which require closer examination. It is hoped that as a result of this project, proposals may be developed to aid in improving the water flow through the Glow-worm Cave so that sedimentation is limited and the valuable glow-worm assemblage may be maintained.

Reference

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ATEA KANADA

JULIA JAMES*, RANDALL KING † and NEIL MONTGOMERY††

Abstract

The Atea Kanada, located in the tropical rainforest of the Southern Highlands of Papua-New Guinea was investigated during the 1976 Muller Range Speleological Expedition. In the course of the expedition, 4 kilometres of cave passage in the Atea Kanda were mapped, a 5½ kilometre survey between the Atea sink and its resurgence undertaken; and a preliminary speleological study was made of the Atea system. Various results of this investigation : area physiography, hydrology, cave map and description, geology and the cave's future potential as a contender for the Southern Hemisphere depth record are discussed.

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* Dept. of Inorganic Chemistry, University of Sydney, NSW 2006

† 9 Wyong Road, Mosman NSW 2088

†† 18 First Avenue, Epping NSW 2121