



# GROWTH AND COLLAPSE OF MUD-MOUND SPRINGS OVER A WEATHERED BASALT AQUIFER IN NORTHERN N.S.W.

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## INTRODUCTION

The growth and collapse of mud mounds at two sites in northern NSW was observed. Detailed investigations were carried out at one site in the Goran Basin, where mounds grew from a flat field in 1989 to measure 4-8 m in diameter and 1.2 m high. Despite the recent appearance, and then collapse of the mounds in 2001, archaeological evidence indicated active springs at the site in the late Pleistocene or early Holocene.

There was concern that the emergence of the springs indicated the onset of higher water tables that could lead to dryland salinity development in the area. Understanding the origin and likely further development of the mud-mounds was therefore important for salinity management.

## INVESTIGATION TECHNIQUES

- interpretation of airborne imagery
- analysis of regional and local geology
- surface geophysics including electromagnetic mapping, electrical imaging and seismic refraction
- drilling, core recovery and piezometer installation
- borehole geophysics
- hydrochemical sampling, analysis and modeling

## POSSIBLE MECHANISMS

Three scenarios for the growth of mounds were possible:

1. regional groundwater flow discharge
2. initiation of spring flow at a recharge rejection location
3. instability caused by intermittent deep gas discharge

The first scenario was ruled out because no deep groundwater was detected during drilling.

Figure 1 Initial mechanism suggested

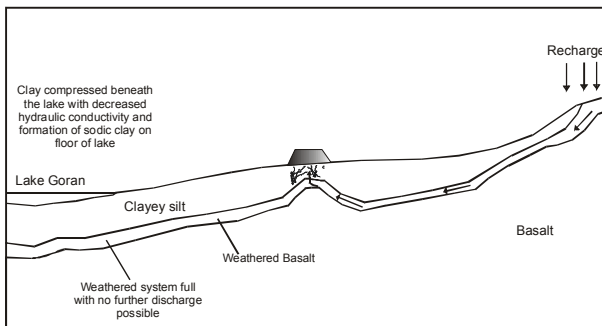


Figure 2 Proposed mechanism based on investigation

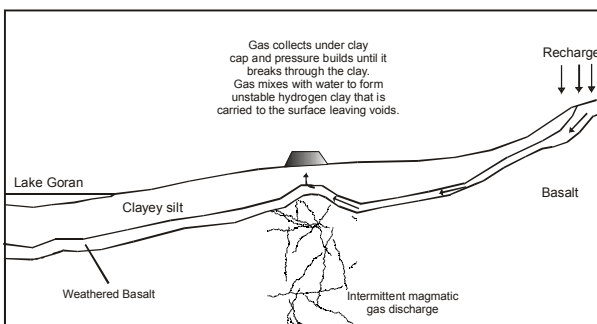
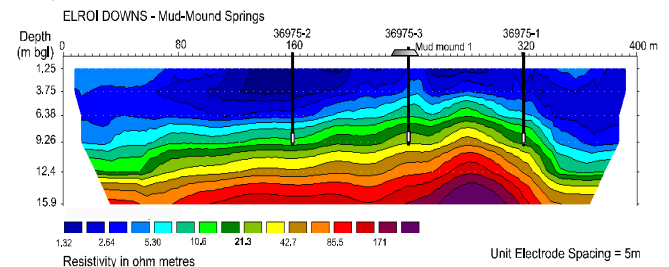


Figure 3 Mud-springs growing in June, 1993 & collapsed in July, 2002



Figure 4 Electrical image showing shallow bedrock beneath mud-spring and piezometer locations



Initial studies considered that the mud-mounds were springs from a local flow system in the shallow weathered aquifer. Under wet conditions, a spring could develop where basalt bedrock was closest to the surface. However, the mounds collapsed after a prolonged wet period following the La Nina episode of 1998/2001. The lack of synchronicity with local rainfall suggested that the mechanism behind the mud-mounds was not linked to a local flow system.

Based on hydrochemical investigation, intermittent gas discharge was proposed as a mechanism. PHREEQC modeling indicated that large quantities of gas discharging from the piezometers were a mixture of N<sub>2</sub> and/or helium and some CO<sub>2</sub>. This is consistent with known magmatic sources in the area, although gas analysis is required for confirmation. It was proposed that proton exchange for sodium on smectite clays, resulted in loss of clay strength and dispersion.

## CONCLUSIONS

The growth and collapse of mud-mound springs appears to be related to intermittent source of deep gas discharge. The collapse of the mounds appears to be related to decreasing gas discharge that allows the clay to seal and reduce discharge. Based on this information, mud-mound development is not directly related to high water tables or salinisation processes.

## REFERENCES

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