Helictite, (2002) **38(1):** pp 17-19

Palaeokarst in the Noondine Chert in Southwestern Australia: Implications for Water Supply and the Protection of Biodiversity

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Abstract

In southwestern Australia, karst features occur in geological formations other than the coastal calcarenites of the Tamala Limestone. The Noondine Chert was formed by the silicification of carbonate rocks and contains relict carbonate textures and palaeokarst features such as intense brecciation and the presence of subsurface voids. This geological formation is an important aquifer to the east of the Perth Basin where groundwater resources are otherwise limited, and the aquifer is highly vulnerable to contamination from agricultural land use. The Noondine Chert may also contain a rich stygofauna. This has not been taken into account in groundwater protection policies, and needs to be assessed as a matter of urgency.

Keywords: palaeokarst, stygofauna, groundwater, management

Introduction

Karst in southwestern Australia is usually thought to be exclusively associated with variably lithified Quaternary calcarenites of the Tamala Limestone that are distributed near the coast between near Shark Bay and the south coast of Western Australia. Although the Tamala Limestone contains karst landforms of national and international significance, the intense focus of karst researchers on this geological formation has distracted them from other potentially karstic geological formations in this region. This bias may be limiting the amount of information that karst landscapes can provide about the natural history of the southwestern corner of the continent.

This paper attempts to partially redress the balance by providing a review of available information on another geological formation in the south-west of Western Australia that has relict karst features. Although the Noondine Chert is unlikely to provide the caving opportunities of the Tamala Limestone, this formation is a regionally-significant groundwater source in an area to the east of the Perth Basin where water resources are otherwise limited, and is likely to be an important habitat for stygofauna in the region. It is hoped that information provided here will stimulate further research into the history of development of karst within this geological formation and its potential role as a subsurface habitat.

Geological setting of the Noondine Chert

The Noondine Chert crops out as a series of low hills to the east of the Perth Basin from near the town of Three Springs to Moora, a distance of about 150 km (Figure 1). This formation is of Proterozoic age and is part of the Moora Group that comprises sedimentary, volcaniclastic and volcanic rocks. The Noondine Chert was originally named the Coomberdale Chert by Logan and Chase (1961) from a type section at latitude 30^{o}25' S and longitude 116^{o} 03' E near the small railway siding of Coomberdale.

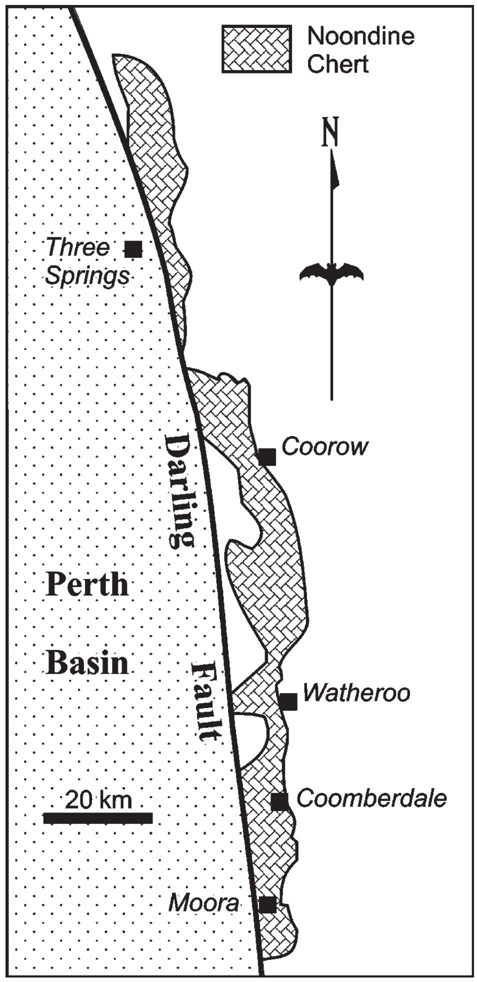

Figure 1: Map showing the extent of Noondine Chert (after Commander, 2001)

It consists of a 700 metre thick sequence of chert, quartzite, chert breccia and partly silicified (commonly dolomitic) limestone and dolostone. The rocks have been relatively unaffected by metamorphism or structural deformation (GSWA, 1990), so most of the original sedimentary textures are well preserved. The chert that makes up the major part of the formation is believed to be the end-product of silicification of carbonate rocks (Playford et al., 1976), and relict dolomite rhombs, oolitic textures, and other features of the carbonate rock are commonly observed in the chert. The formation also contains stromatolites and a "fossilum problematicum" that was identified by Öpik and Tomlinson (1955) as a tabulate coral, possibly belong to the Ordovician genus *Tetradium*. Playford et al. (1976) considered that the supposed fossil was of inorganic origin as the age was inconsistent with the known Proterozoic age of the Noondine chert.

Another possible explanation is that the tubular, hexagonal structures were correctly identified as fossils and were laid down within the limestone during a period of karstification in the Palaeozoic. There may have been several periods of karstification in the Noondine Chert, and extensive karst development probably continued until much of the carbonate rock mass was replaced by silica. The age of the silicification event and the source of the silica is unknown, but could be due to hydrothermal activity associated with the Darling Fault, the structure that forms the eastern boundary of the Perth Basin. The Darling Fault was most active during the Mesozoic during the break-up of Gondwanaland.

Playford et al. (1976) suggested that the Noondine Chert was deposited as a shallow marine limestone and that algal stromatolites grew prolifically in certain areas. They considered that much of the brecciation was due to the slumping of weakly cemented limestone, although much of the brecciation could also be due to later karst development. Playford et al. (1976) considered that the limestone was partially dolomitised, either soon after deposition, or early in its diagenetic history. The Noondine Chert was intruded by a number of dolerite dykes some time during the late Proterozoic, and the metasomatic alteration of dolomite near some of the intrusions created talc deposits such as the Three Springs deposit.

Another area of extensive palaeokarst occurs further north in the East Pilbara area as the Pinjian Chert Breccia that has developed on the Proterozoic Carawine Dolomite (e.g. Williams, 1989). That area also has scattered younger caves and dolines (Webb, 1994). A summary of that area is given by K. Grimes on page 20 of this issue of *Helictite*.

Development of subsurface voids

A few small caves and dolines have been listed for this area (the Moora Karst Area) in the Australian Karst Index (Matthews, 1985). Bastian (1962) described and provided a map of the largest cave (6M-1) near Coorow which has 550 m of joint- and strike-oriented maze passage and a bat colony. Bridge (1962) reported copper phosphate minerals from another cave (6M-6), near Watheroo.

There is ample evidence from drilling for water supply that the Noondine Chert is extensively fractured and contains substantial subsurface voids, although there is no information about the size of these voids. Commander (2001) indicated that the chert is cavernous and is capable of high bore yields, with yields of up to 1000 $m^3 day^{-1}$ being recorded from individual production bores (Berliat 1964; Playford et al., 1976). The origin of the voids is unknown, but could be due to the dissolution of residual carbonate minerals within the chert matrix.

Monitoring carried out in the Coomberdale water supply borefield has indicated that a large amount of groundwater flow also occurs in zones of highly brecciated chert (Water Authority, 1998). This monitoring has also indicated that there is a strong hydraulic connection between rubbly outcrops of Noondine Chert on high ground and shallow, high-yielding bores downslope, suggesting that fractures and voids in this formation are well inter-connected.

Implications for the protection of groundwater

The highly cavernous and fractured nature of the Noondine Chert make this aquifer particularly vulnerable to contamination from agricultural land use in the region. A number of towns either partially or totally rely on groundwater pumped from the Noondine Chert for water supply, including Moora, Coomberdale and Watheroo, and as a consequence protection plans have been developed (see eg. Water and Rivers Commission, 1999a; 1999b) to ensure that groundwater contamination does not affect these water supplies.

Of more concern is the fact that groundwater protection planning has not taken into consideration the possible impact of groundwater contamination and pumping on stygofauna that may live in the Noondine Chert aquifer. Western Australia has a rich natural heritage of animals that have adapted to living within groundwater flow systems (Humphreys, 2002) and they are an important part of the State's biodiversity that is unseen and unrecognised by the general community. The size and diversity of stygofauna is greatest in aquifers with large void spaces, and the Noondine Chert may be an aquifer with a particularly rich subterranean fauna. This needs to be assessed as a matter of urgency. It would be tragic if this fauna was lost through inappropriate land use practices before it was even recognised.

References

Bastian, L. 1962 The Caves of Coorow. *Western Australian Speleological Group Journal* **1962**: 44-50

Berliat, K., 1964 Report on drilling for underground water – Watheroo town supply. *Geological Survey of Western Australia, Record* 1964/21.

Bridge, P., 1962 Some minerals in Western Australian Caves. *Western Australian Speleological Group Journal* **1962**: p. 51.

Commander, D.P., 2001 Notes for the Zone of Rejuvenated Drainage, Western Australia Groundwater Atlas. Available at website "http://www.wa.gov.au/ westfish/aqua/broc/groundwater/sw-ag-rejuvanated_drainage.html"

GSWA (Geological Survey of Western Australia), **1990** Geology and Mineral Resources of Western Australia. *Geological Survey of Western Australia, Memoir* **3:** 827 pp.

Humphreys, W.F., 2002 Groundwater ecosystems in Australia: an emerging understanding. Proc. International Conf. "Balancing the Groundwater Budget", Darwin, May 2002.

Logan, B.W. and Chase, R.L., 1961 The stratigraphy of the Moora Group. *J. Roy. Soc. W.A.* **44:** 14-31

Matthews, P.G., 1985 *Australian Karst Index*, Aust. Speleological Federation, Broadway, NSW. page 6-13.

Öpik, A.A. and Tomlinson, J.G., 1955 Fossils from Yandanooka, Western Australia. *Aust. Bur. Mineral Resources Rec.* 1955/104 (unpublished).

Playford, P.E., Cockbain, A.E. and Low, G.H., 1976 Geology of the Perth Basin, Western Australia. *Geological Survey of Western Australia, Bulletin* **124**.

Water Authority of Western Australia, 1998 Coomberdale Water Source Scheme Review (unpublished report.)

Water and Rivers Commission, 1999a Coomberdale Water Reserve Water Source Protection Plan. Water and Rivers Commission, Report **WRP1**, Available at website "http://www.wrc.wa.gov.au/protect/watersupply/coomberdale.pdf"

Water and Rivers Commission, 1999b Watheroo Water Reserve Water Source Protection Plan. Water and Rivers Commission, Report **WRP21**. Available at website "http://www.wrc.wa.gov.au/protect/watersupply/watheroo.pdf"

Webb, R., 1994 A new caving area—East Pilbara. *The Western Caver,* **34:** 51-53.

Williams, I.R., 1989 Balfour Downs, Western Australia. *Geological Survey of Western Australia 1:250 000 Geological Series—Explanatory notes.* **SF 51–9.**