Karst and Pseudo-karst in Victoria: an Overview

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Abstract

This paper will give an overview of the many caves and related landforms known in Victoria, but will concentrate on the karst and pseudokarst of Gippsland.

Some are true karst but others are volcanic caves and pseudokarst. These features have scientific, recreation, aesthetic, conservation and education values and are an important part of the state's heritage. The karst and pseudokarst features are the result of the following natural processes: solution, precipitation, volcanism, weathering, piping, and wave action. Some karst is buried under the volcanic flows of western Victoria.

Solution and precipitation, primarily of carbonate rocks is the single largest group. These fall into two groups, widely separated in geological time: karst in the Palaeozoic limestones, mainly in the eastern part of the state, and that in Cainozoic limestones which are found from East Gippsland to the South Australian border. The next largest group is the volcanic caves of the Western District Volcanic Province, many of national and international geological significance. Significant caves are found in a range of other rock types including granitic rocks, quartz sandstones and silcrete.

Introduction

This overview paper will provide an introduction to the various karst and cave areas of Victoria with special emphasis on their geological setting. It is a minor revision of the chapter in the Guidebook for the 20th ASF Conference, Vulcon (Baddeley, 1995). The areas in East Gippsland are described in more detail in the Guidebook for this conference.

Victorian Cave Types

Victorian caves are not particularly notable in the ways that people often regard karst features. They do not rank amongst the longest, deepest, or largest cavern size in any type of ratings. Few caves have outstandingly spectacular speleothems, although there are some caves with very beautiful decoration. However, there is a great variety of caves in Victoria, both in type of host rock and in cave form.

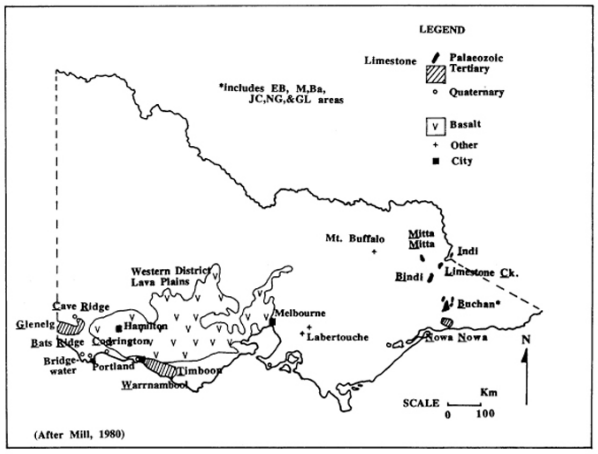

Figure 1: *Map of cave and karst areas of Victoria.*

The vast majority of the karst areas in Victoria are to the south of the Great Dividing Range. To the north are the flat, dry plains of the Murray Basin where conditions conducive to cave formation are rare, and so there are very few caves (Fig. 1).

Victoria has limestones ranging in age from the Cambrian to the Quaternary. Only limestones from the Silurian, Devonian, Tertiary and Quaternary are pure enough and extensive enough for caves.

There are five major categories of cave and karst landscape described; only two of these are in limestone (White, 1990).

1. Palaeozoic limestones

Caves are found in both Silurian marbles and Devonian limestones of Eastern Victoria, which tend to be pure (high $CaCO_3$ content), massive, well jointed and in areas of relatively high relief and annual rainfall. Most of them are impounded karst where areas of soluble rock (limestone) are completely surrounded by non-soluble rocks. Such topography gives good conditions for the formation of karst landforms. The caves in these areas consist of three main types:

Figure 2: *Decoration in Royal Cave (B-6), Buchan (Photo N.White).*

(a) Stream Passage Caves Formed by perennial and intermittent streams, some examples show older abandoned high levels. Many are well decorated (Fig. 2) but not all are. Good examples include the tourist caves at Buchan, Wilsons Cave (EB-4) and Scrubby Creek Cave M-49 (Fig. 3).

(b) Vertical Potholes These vary from blind shafts, e.g. Baby Berger (M-14), to complex examples with both vertical and horizontal development, e.g. Honeycomb (M-41), Jam Pot (M-48) (Fig. 4) and Exponential Pot (M-125). Again there is a great variety of decoration.

Figure 3: *The sump in Scrubby Creek cave (M-49) (Unknown photographer)*

These caves form as a result of solution along the intersection of joint planes.

(c) Collapse Caves These caves formed due to the collapse of roof material, e.g. Anticline (M-11).

Karst areas where such caves are found include the Buchan Valley, Limestone Creek, New Guinea Ridge and some other small areas in East Gippsland.

Research over the past 20 years shows that many of the caves in areas such as Buchan are extremely old, and places such as the Potholes have been subjected to inversion of relief, i.e. what is now on the top of a main ridge,

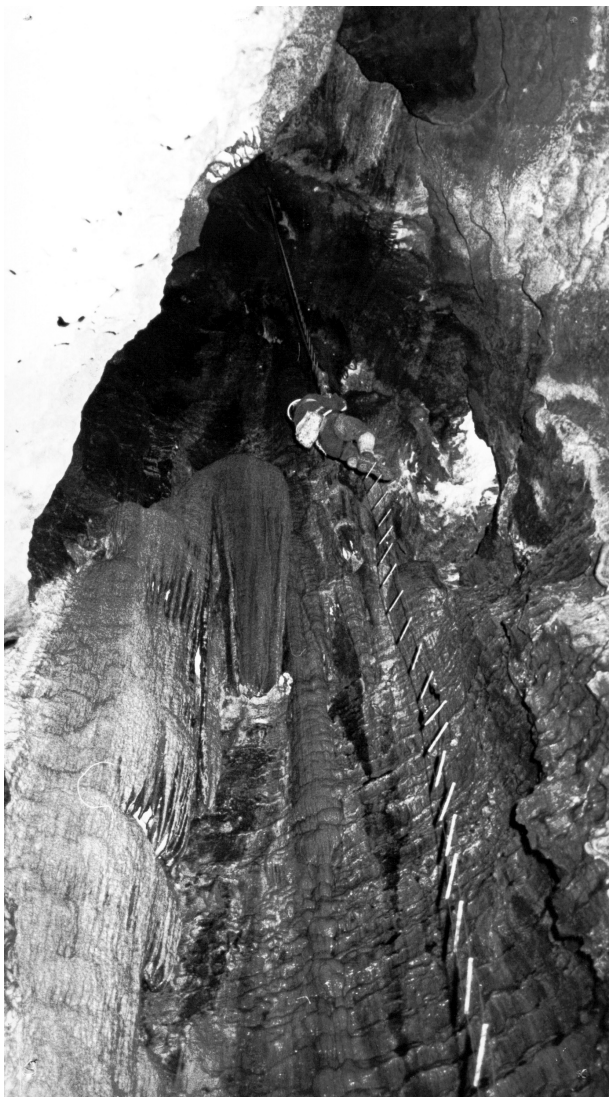

Figure 4: *Vertical pothole Jam Pot (M48) (Photo: R. Frank)*

200 m above the present river valleys, was the valley bottom (Finlayson et al. 1992). The caves were therefore formed below the water table before the landscape was lowered by erosion.

2. Cainozoic limestones

There are large areas of Cainozoic limestone in Western Victoria and South-Eastern South Australia, but variety in density of cave development in this province (Fig. 5). There are some areas with intense karst development, and yet other areas, sometimes not far away, where there is little development at all. The reasons for this are not very well understood, but appear to be at least partly related to the purity of the limestone. There is certainly sufficient rainfall. Compared with the caves in Palaeozoic limestones, there is more variation in the limestones, lower relief and very few joints.

Examples of Cainozoic limestone cave areas include Glenelg, Bats Ridge, Codrington, Timboon, Warrnambool, and Naracoorte. These caves tend to be horizontal, have collapse features, and are often multientrance. The quantity of calcite decoration is highly variable, the most common is moonmilk. The presence of solution pipes is a prominent feature in many areas (Fig. 6).

Some Quaternary dune limestones show syngenetic karst development where prominent features include a cemented (calcreted) cap-rock near the surface, vertical solution pipes and low wide horizontal maze caves either just beneath the cap rock or at the level of the surrounding plains. The poorly consolidated nature of the rock means that collapse plays a very important role.

In all of the Cainozoic limestone areas solutional, subsidence and collapse dolines are important, and there is a large doline field in the Peterborough area that is largely undescribed.

3. Basalt

The Western District lava plains extend from Melbourne to about 50 km west of Hamilton, with an isolated flow at Mt. Gambier. They were formed during periods of volcanic activity in the late Tertiary and early Quaternary. Fluid lava erupted from fissures and shield cones and spread across large areas. One theory is that as the top layer of lava cooled, the still liquid lava below drained away, leaving lava tubes and caves. They vary from simple tubes to complex branching and multi-level tubes and other forms as well, e.g. Mt. Eccles (Fig. 7), Byaduk. Other spectacular volcanic features are also present such as volcanic cones, tumuli and stony rises (Fig. 8).

4. Acid igneous rocks

These have never been thought to be very important for caves, but are now known to be more common and extensive. The main rocks are granite and granite-like rocks and examples of caves are found at Labertouche, near Warburton, Tynong, and Neerim South (Fig. 9). Other igneous rocks also show cavities similar to this. A small cave on Mt. Bogong is an example. Very interesting, small and rare opaline decoration is found in some.

There is a variety of forms from rockfall type to enlargement of joints in solid granitic rock. These areas

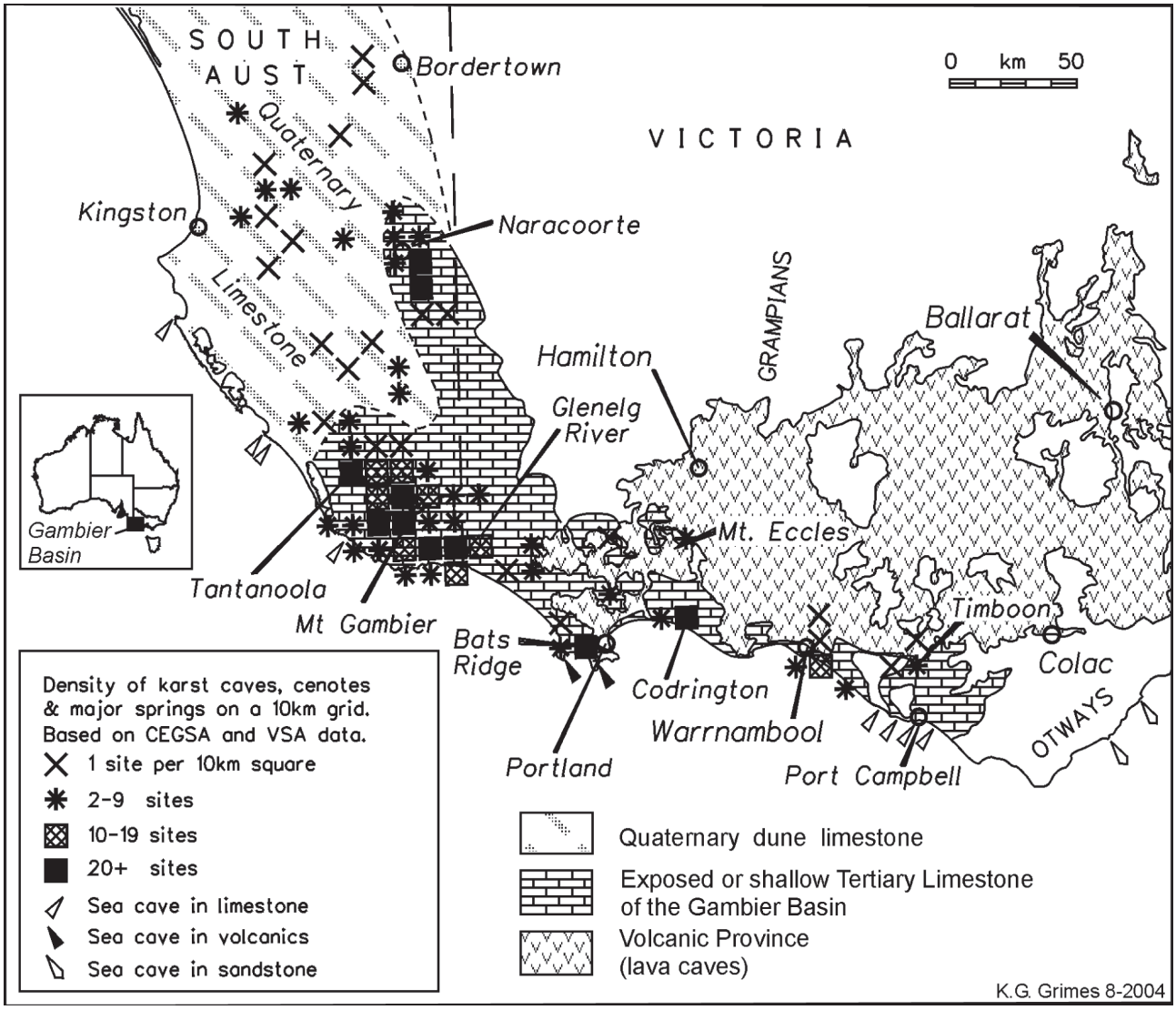

Figure 5: *Density of cave and karst features in western Victoria and southeastern SA (K.G. Grimes 2004).*

are not described in detail in this field guide. The cave areas in this rock type are generally in eastern Victoria, but there are features similar in the Black Range granites in the Grampians area and Melville's Caves near Inglewood.

Finlayson (1986) describes three different types of caves in granite; boulder caves, open joint caves and closed joint caves. The boulder cave type includes two sub types; caves in boulder piles, such as Melville's Caves and caves in boulder filled channels, such as Labertouche Cave. In both cases the more weathered material around the boulder cores (grus) is removed. Open joint caves are formed by weathered material being removed from an open joint and roofed by boulders dislodged during the excavation of the joint. The best known example of this is River Cave, Girraween, in southern Queensland. Closed joint caves are formed by erosion along a joint. The only known example is Goebel's Cave at Girraween, Queensland.

Granite boulder caves are not uncommon in Victoria. The best-known and particularly well developed example is located in the headwaters of Labertouche Creek about 100 km east of Melbourne (Fig 9.). The bedrock is a Late Devonian granite known as the Tynong Granite.

Figure 6: *Solution pipe G-10 Glenelg River (Photo R. Frank).*

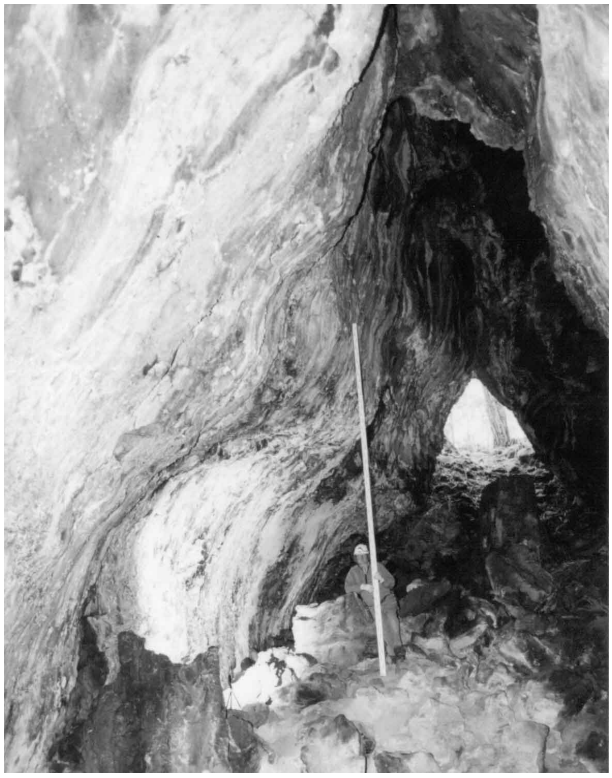

Figure 7: *The ceiling of Natural Bridge (3H-10), Mt. Eccles, has a "Gothic" shape that suggests it formed by levee overgrowth. (Photo K. Grimes).*

Figure 8: *Stony rises near Lake Condah, on a 30,000 year old lava flow from Mt. Eccles. (Photo K. Grimes).*

The cave is formed in a blind valley with the crest of the col terminating the valley about 25 m above the stream level. The 175 m of cave passage is comprised of spaces between the boulders.

5. Miscellaneous

These include sea caves in basalt (Cape Bridgewater), sometimes with limestone overlying the basalt (Fig. 10); mudstones (Cape Liptrap), sandstones (Cape Patton, Cape Otway area, Cape Paterson, San Remo, Mt. Speculation), basalt (Cape Bridgewater) and caves behind waterfalls such as Den of Nargun in Mitchell River National Park. Included with this group is the extensive series of overhangs in the Grampians which are still undescribed in cave or karst terms, but which have important art features on their walls.

In most of these cases, erosion of weathered material has occurred along planes of weakness or by abrasion from high-energy waves or streams. The arkosic sandstones and mudstones of the Otway Group and Strezlecki Group sediments in southern Victoria have significant joint enlargement caves at or just above sea level and at the coast.

Summary

Caves in Victoria have been known and used by man for a long time. Aboriginal Victorians have left evidence of using caves as habitation sites (Cloggs Cave, East Buchan) (Flood, 1980) and as art sites (Grampians and New Guinea Ridge). European interest in caves in the Buchan area is reasonably well documented since the visits by geologists such as Howitt and Stirling in the 1880s.

Nineteenth century interest in the caves of western Victoria is less well known. James Bonwick, a school inspector who travelled around south-western Victoria published descriptions of caves and karst in 1858 (Bonwick, 1878). Many detailed descriptions of the unusual mineralogy in Skipton Lava Cave were published in the 1870s and 1880s. The volcanic caves have been described in detail over the past century but less was

Figure 9: *Top entrance Labertouche granite boulder cave (Photo N.White).*

done on the karst areas of the Cainozoic limestones. Some descriptions are available but they are often hidden among other geological material.

The perception that Buchan is the only cave and karst area of interest in Victoria is no longer valid. The impression that one has about Victorian caves and karst areas is that there is immense variety of types and forms. There are many areas with small but very interesting caves in host rocks which are unusual, and new caves and new areas continue to be discovered.

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Figure: 10 *Sea cave in basalt; tufa and aeolianite overlying the basalt, Cape Bridgewater (Photo E. Hamilton-Smith).*