Geology, Environment and People on the Western Plains of Victoria, Australia

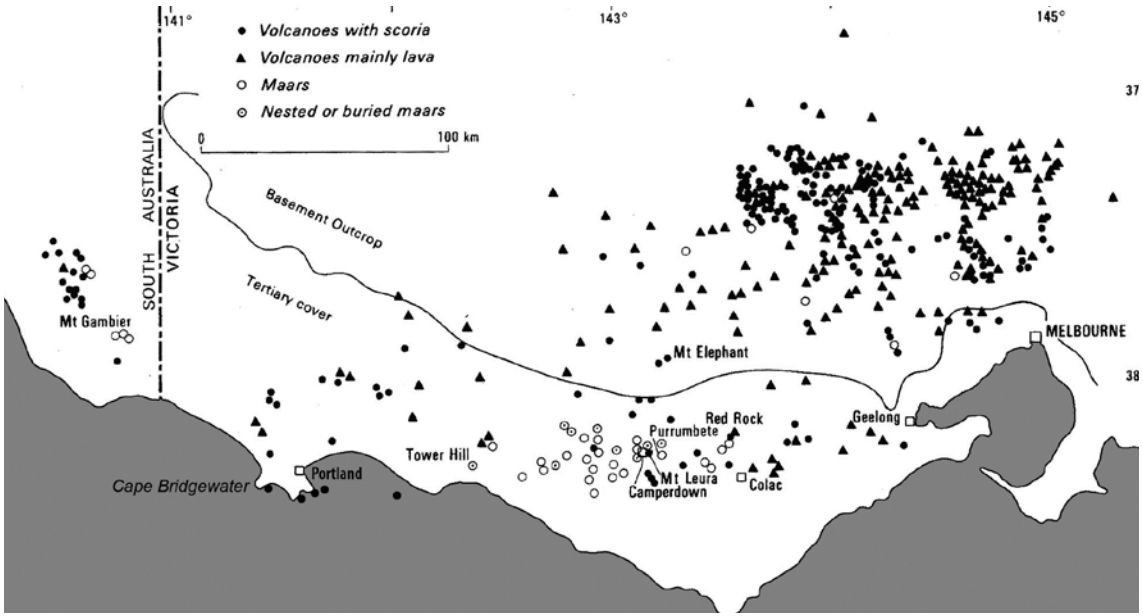


Fig. 1. Locality map of the Western Plains with volcanoes

The Western Plains form a distinctive grassland landscape within south-eastern Australia, characterised by recent volcanic activity (Fig. 1), with well-preserved cones, craters and flows, and the development of rich soils. Both lunette lakes and crater lakes mark the central part of the Plains, and swamps and former lakes are widely distributed. Water in streams and at shallow depth is often affected by salinity, but fresh groundwater occurs at depth and also within young basalt lava flows. These features of the landscape strongly influenced the European settlement of the region in the nineteenth century and control its current development (Joyce 1984).

Broad, sunlit grasslands stretch to the horizon, broken only by elegant stone fences; tall trees surround old stone mansions; prosperous towns reflect their nineteenth-century heritage and their surrounding sheep and dairy cattle properties; the lakes and craters of an old volcanic landscape provide a heritage of rich soils and an attraction for tourists. The explorer Major Mitchell described it in 1836 as "a region more extensive than Great Britain, equally rich in point of soil, and which now lies ready for the plough in many parts, as if especially prepared by the creator for the industrious hands of Englishmen" (Mitchell 1838).

Yet at other times hot winds raise the dust on parched drought-starved land; streams charged with salty groundwater seep past bare banks into salt lakes where only salt-tolerant plants can survive; old farm buildings lie abandoned where once-prosperous family farms no longer provide a living. The landscape, soils and waters of western Victoria provide a canvas on which climate and humans are painting a changing picture which may differ according to the observer's viewpoint. To understand this intriguing landscape we need to know how its

geology has determined the environment of the area and today continues to interact with climate and people for both good and bad.

THE AREA

The Plains are flat. The old Tertiary sea floor, which some 30 million years ago stretched inland to the edge of the West Victorian Uplands, waves lapping against the higher country (see boundary of Tertiary cover in Fig.1), now has a partial cover of younger lava flows, with scattered shallow lake basins and fringing lunette ridges (Fig. 2), as well as surviving remnants of the now-weathered old sea floor. Relief is low, reaching only to 15 or 20 metres on the young stony rise lava flows (Fig. 3), or where one of several small fault scarps has broken the surface of the Plains. The most striking features of the landscape are the many scoria cones (also called cinder cones) such as Mt Porndon (Fig. 4), which rise 50 metres or more above the Plains. Mount Elephant is the highest, at nearly 200 metres, with its hidden crater reaching 120 m down into the pile of scoria built up by volcanic activity; it was known to early travellers as "The Lighthouse of the Plains". An even deeper crater is found at Mt Noorat (Fig. 5). Rosengren (1994) has described the volcanoes of the region, and his descriptions can also be viewed online (web reference 1). The scoria cones, or the related low-lying lava shields, are the sources of the extensive Stony Rise lava flows characteristic of the Western Plains (Joyce 2004). Less obvious are the many deep craters which pockmark the Plains, sometimes with lakes e.g. Gnotuk, Bullen Merri. These volcanoes erupted ash, triggered by the interaction of groundwater and rising hot magma in the volcanic neck, forming a ring of volcanic sediments around the deep crater (Birch 1994). Such volcanoes are known as **maars**, a term used in the Eifel region of Germany. About 100 individual volcanoes can be found across the Western Plains, and their ages cover the range from five million to five thousand years ago.

Western Victoria gets first go at the weather. Frontal changes sweep in across Bass Strait and rain falls near the coast, then decreases towards the northern part of the Plains to less than 500 millimetres a year. It increases again where the Plains begin to rise up to the north into the higher region of the West Victorian Uplands.

Droughts are a feature of the region, as in other parts of Australia. Dust storms are raised by strong winds across the largely treeless plains. The volcanic soils yield clay dust, which begins moving under northerly winds preceding a cool change and is then carried by the strong southwesterly winds that follow over Geelong and Melbourne. This happened in spectacular fashion in 1983 when a rolling dust cloud began in far northern Victoria, reached the Western Plains and then turned eastwards to black out the city – becoming known as the great Melbourne dust storm.

Grass fires are also a feature of the grassy plains, and in the summers of 1942, 1977, 1983, and 2009 large areas were burnt, and long runs of fencing, farm buildings and houses were lost, and on the 12th February 1977 most of the town of Streatham was destroyed.

The Plains are natural grasslands. The European trees surrounding old homesteads, such as pine and cypress, were planted to protect elaborate gardens and provide memories of Europe, and many roads are lined with sugar gum plantations to break the cold winds and protect stock in winter. Elsewhere, introduced grasses provide stock feed, and roadside reserves have been registered on the National Estate to help protect the few remaining areas of native grasses and their fauna.

The rivers and streams that cross the Plains have large catchments but low runoff. Much rainwater goes underground, and any shallow groundwater that returns to the streams is often saline. In summer

Fig 2. Looking north along the grassed crest of the lunette ridge of Lake Gnarpurt, recently beginning to erode by wind action

Fig 3. Mt Porndon Stony Rises, with a long stone wall crossing the rises and depressions

Fig 4. Mt Porndon scoria cone with its surrounding Stony Rises and a striking stone wall

Fig. 5. Central crater of Mt Noorat volcano, more than 150 m deep

Fig. 6. Red scoria (cinders) erupted at the Red Rock volcano during a scoria cone building stage, following earlier maar crater formation

many streams are reduced to a series of ponds or become dry.

As settlers arrived in western Victoria, evidence of salinity was soon being recorded. A letter by Robinson describing the salt springs he noted in 1856 near the Dundas Tableland, to the northwest of the Plains, can be found among those addressed to Governor La Trobe by early settlers. A study has made use of early survey maps to show how salinity was already present although often ignored. Salinity on the Western Plains generally has its source in the adjacent highlands and moves out onto the Plains in underground and surface water flow. The ultimate source is cyclic salt, carried inland over thousands of years from the ocean and deposited with rain or as dust. Its expression is most obvious on the flat, poorly drained plains of western Victoria. Salinity is concentrated in the depressions caused by tectonic subsidence or faulting, such as the extensive saline flats around Lake Corangamite. Numerous other lunette-bounded lake depressions, such as in the Lake Bolac area, also have salinity problems, as do some of the volcanic crater lakes, and other depressions due to lava damming of old streams.

Lake Corangamite is sometimes called the creeping lake, and in 1952 its level rose and extended across the adjacent flats, requiring an extensive drainage interception scheme to be installed. Salty river water was directed into the Barwon River scheme, already with its own salinity problems. Later the lake level fell again; fluctuations of this type are known to have happened several times in the past, and probably represent minor variations in the precipitation, evaporation and groundwater balance of the region. Groundwater is a major attribute of the region and ranges from excellent quality and abundance in young stony rises to high salinity and scarcity in older flows. Large springs discharge from the young stony rises region around Mount Porndon into the south end of Lake Corangamite, enough to almost turn that part into a freshwater lake if it could be cut off from its northern part. Groundwater in the stony rises around Red Rock, near the north-eastern shore of Lake Corangamite, is pumped from the basalt aquifer and used to irrigate peas, beans and other plants, allowing several crops to be raised in one year on the rich ash soils which overlie the stony rises. This has lowered the groundwater level in the stony rises, affecting the level of water in the Red Rock crater lakes (Fig. 6), and perhaps also in the adjacent Lake Corangamite. Groundwater is also available from some large scoria cones and has been used for town supply – for example at Mount Noorat and Mount Shadwell.

Vegetation records for the region are good, ranging from Major Mitchell's exploration report in 1836 to settler diaries and letters solicited by the first governor, La Trobe. Such records were later compiled by Everett in 1869 into a state map which depicts the largely grassland plains, with some limited areas of forest or woodland on the young stony rises (Fig. 7), on some of the scoria cones, on the nested cones of the Tower Hill maar volcano (Fig. 8), and also in the area still called Framlingham Forest, the site of an early mission and later Aboriginal settlement.

The soil types may be the reason grasses grow naturally on much of the broad clay plains while trees do not. Heavy clay soils have formed on weathered basalt flows and on the exposed Tertiary sediments alike, swelling and shrinking with moisture changes and perhaps damaging tree roots. Another explanation suggested for the origin of the natural grasslands is the former regular burning by Aboriginal peoples until dispossessed by European settlers.

THE STONY RISES

Fluid basalt flows have spread laterally around volcanic vents, and often for many tens of kilometres down river valleys. Where the lava flows have blocked

drainage, lakes and swamps have formed. The name **Stony Rises** comes from the area of that name around Mount Porndon, near Lake Corangamite (Figs 3 & 4) and is now applied generally to some dozen or so different areas of young lava flows across the Western Plains.

Many of the stony rise lava flows are young, erupted during the last 50,000 years or so, and form 'stony rises' with a characteristic internal relief of up to 20 m. Young stony rise lava flows generally have sharp boundaries, commonly stepping down onto the surrounding plain by up to 15 m, and are readily recognisable by their characteristic irregular stony surfaces, thin soils and woodland cover. These young lava flows have a shallow, brown to black clay soil through which boulders protrude on the slopes and in depressions. More continuous rock cover is found on the crests of the young rises. The stony rise flows form extensive areas around individual volcanoes (e.g. Mt Eccles, Mt Napier, Mt Porndon), having spread radially as a series of lobes which overlapped to build up a sheet of lava. The outbreak of tongues of liquid lava from inside the lobes and the collapse of the original surface over the evacuated area have also helped formed the irregular hummocks, ridges and sinuous or basin-like depressions of the stony rises.

Older stony rise flows, some up to several hundred thousand years ago, are generally more weathered and less stony e.g. Mt Rouse, Mt Noorat, The Sisters and Mt Warrnambool.

Lava tubes or tunnels, known locally as lava caves, are a major feature of the stony rises of the Western Plains, and the caves of the Byaduk area in the flows from Mt Napier, and the caves of the nearby Mt Eccles complex, are geological heritage features of international significance.

The younger soils on the stony rise lava flows are full of rounded or angular stones which have been collected into heaps to clear the paddocks, and often provided more than enough stone to build long stone walls. Native woodland grew on the young stony rise flows, the roots finding sustenance in the soil-filled cracks in the rock. Apart from these more stony areas, the adjacent flatter and older weathered Western Plains are grasslands and ideal for grazing, as Mitchell noted in 1836. Even on the stony rises themselves, rich young soil between the rocky boulders can supply bountiful food for dairy cattle. The ash soils around maar volcanoes such as Tower Hill and Red Rock support intensive farming of potatoes, beans, peas and similar crops, sometimes assisted by irrigation in dry seasons.

NINETEENTH-CENTURY SETTLEMENT

The first settlers were squatters who took up large properties for sheep grazing and in a run of fortunate years in the 1860s made sufficient money to build large houses and found family fortunes, not always retained for following generations. However, these settlers stamped their mark on the landscape with stone walls (Corangamite Arts Council, 1995), as well as small and large farm buildings including handsome shearing sheds of basalt blocks – known usually as "bluestone". In places circular sheepfolds can still be found; these were built of bluestone to house and protect sheep overnight. At first, sheep were left in charge of shepherds who had to remain with their flocks day and night, enclosing them in portable hurdles to make temporary fences. The later introduction of fencing wire (and then barbed wire in the 1870s) allowed paddocks to be fully fenced.

This landscape – in particular its homesteads, but also the plains, waterfalls, and stony rises – was immortalised by artists, especially the German painter Eugene von Guerard (Pullin, this book). The botanist William Guilfoyle, who established the famous botanic gardens in Melbourne, also helped design individual gardens around homesteads and in the new towns such as Camperdown and

Fig. 7. The Tyrendarra Stony Rise lava flows from Mt Eccles volcano, in the eel traps area of the National Heritage Landscape at Budj Bim, showing columnar cooling joints

Fig. 8. Old quarry face at Tower Hill volcano, showing bedded volcanic ash (tuff) deposited during the maar eruption stage 35,000 years ago, and now eroding into hollows used by nesting birds

Colac. As well as sheep, cattle and horses, whose hard hooves rapidly compacted the surface of soils adapted only to the soft pads of kangaroos and emus, settlers brought in from overseas an array of other animals and plants in a process called "acclimatisation", which was often a nostalgic attempt to recreate European landscapes. At Barwon Park near Winchelsea, the squatter Thomas Austin successfully introduced many game birds and animals, but his greatest success was with rabbits; from his few jealously guarded pairs, rabbits were to spread rapidly across most of the continent. Grasses introduced for the new grazing animals also began to replace the native grasses and other plants.

CONTRASTING THE PRE- AND POST-SETTLEMENT LANDSCAPE

From descriptions of the early landscape we know that the Plains were already well stocked with food animals when Mitchell arrived, and it is estimated that a large Aboriginal population was able to live well on the grassy plains, with coastal, lake and river food sources also available. In the lakes and marshes formed as a result of the youngest volcanic activity, where eels migrating inland to breed could be confined and captured, Aborigines had constructed elaborate stone water channels and traps (Fig. 7). So rich and regular were the food supplies that villages of stone houses were built in areas such as the stony rises around Condah Swamp near Mount Eccles (Builth, this book).

From the early settlement records it is possible to reconstruct an original vegetation map. Extensive natural grasslands grew on the swelling clay of the plains formed by weathering of the older lava flows. These plains were broken by numerous swamps, marshes, and large and small lakes – some salty but more rarely fresh. The younger lava flows stood up as stony rises, their rocky outcrops shaded by trees which flourished in the soil-filled cracks between the rocks. On the oldest lava flows such as those near Hamilton, lengthy weathering has produced deep, non-swelling clay soils with a sandy topsoil added over many years by past wind activity. Here elegant leaning red gums of great age provided a park-like landscape that attracted the earliest settlers such as the Hentys, with its reminders of a nobleman's park in Britain.

The coming of explorers, and then settlers and their hungry stock, to this Arcadian (though occasionally hot or cold, and dry and salt-affected) landscape, with its settled Aboriginal population, was often catastrophic. Opposing cultures and opposing demands on the landscape soon led to conflict. Only recently has the full extent of the Black Wars, as they are now being called, and the fighting which led to the deaths of both Aboriginal and white settlers, been spelt out. In these conflicts, the stony rises provided an effective refuge for the Aborigines. The greater numbers and organisation of the new settlers, coupled with the effects of introduced diseases, led to a swift decline in the Indigenous population, with the scant survivors moved to reserves and missions by well-meaning governments. Near Framlingham, adjacent to one of a few small surviving forest areas, the former mission is now an Aboriginal settlement. The interruption to the way the indigenous people had worked and looked after their country for tens of thousands of years was drastic, and it was yet another factor in the way the landscape, soils and vegetation were to change over just a few years.

THE PREHISTORIC LANDSCAPE OVER THE PAST 40,000 YEARS

Good evidence exists for even earlier landscapes in western Victoria. Pollen studies in cores taken from lakes, including in several volcanic craters, show how vegetation fluctuated with the cooling and warming that has characterised the last 100,000 years. When Tower Hill volcano erupted over 35,000 years ago (Fig. 8) it was in a very different landscape. Trees were absent, and a much colder climate allowed only

seasonal grasses to grow; strong westerly winds raised dust from the often bare earth, and sand and silt were being added to the heavy clay soils on the lava flows; near the present South Australian border sand dunes were actively moving eastwards. In contrast, lakes were full, and often freshwater, and rivers larger than today's ran southwards towards the sea, but the coastline was then hundreds of kilometres away, across what is now Bass Strait, where now-extinct megafauna such as the giant kangaroo and diprotodon were living on a treeless grassy plain which stretched to Tasmania.
Perhaps a dozen volcanoes may have erupted within the last 20,000 to 30,000 years - this would be an eruption every 2,000 years or so (Joyce 2004) and thus witnessed by Aborigines living in the area.
It was this landscape that Aborigines would have known, and during their continuing occupation it would have been further altered as they farmed it with fire. The landscape was also to change as climate changed, warming up after cold Ice Age conditions, with the sea level rising again so that the land shrank back to the present shoreline. Trees returned, the groundwater became more salty, and rainfall and temperature fluctuated, at some times being even warmer than today. When Europeans arrived, many crater lakes, now shallow or dry, were overflowing.

THE FALLING LAKE LEVELS OF WESTERN VICTORIA

Early settlers soon noticed that many of the area's lakes were falling in level. New beaches were developing and former lake sediments emerging, and large stumps and fallen trunks appeared as the water level fell in several maar crater lakes. Freshwater springs that had formerly fed directly into the lakes were now emerging well above lake level. The State Rivers and Water Supply Commission, a Victorian government department, tracked these changes at Lake Gnotuk and Lake Bullen Merri and used historical records to show that the levels were falling consistently at a rate of some twenty centimetres per year since the first observations by settlers, decreasing to about 10 centimetres a year since 1950. Benches higher on the crater walls allowed the record to be taken back further. Radiocarbon dating of the emerging trees gave ages of about 2000 BP (Fig. 9) and their state of preservation showed that they had been underwater since they were drowned by an earlier lake level rise. At the nearby Lake Keilambete crater lake, Jim Bowler was able to establish a chronology using the exposed beaches, lake sediments and radiocarbon dating to show that the crater lakes had a long history of fluctuations in water level for over 30,000 years. The lakes were acting as climatic recorders, with their levels responding to changes in regional precipitation/evaporation ratios.

Fig. 9. 2,000 year old tree encrusted with lake carbonate coating, on the eastern shore of Lake Bullen Merri maar crater, Camperdown

Fig. 10. Botanical Gardens lookout at Camperdown, looking north to Lake Gnotuk maar crater lake, with geological heritage signboard

Bowler realised that these changes provided a unique record of past climatic fluctuations, with the latest changes being possible evidence for a recent warming, consistent with a Greenhouse-related change. In some crater lakes the falling levels have led to complete drying, for example the former Lake Terang, and more recently Lake Wangoom.

The Western Plains contrast with many other areas in south-eastern Australia, where settlement and the subsequent clearing of trees have led to a general rise in water table; here on the Plains, which have remained largely grasslands, this has not happened to the same extent.

THE LANDSCAPE TODAY – A HUMAN LANDSCAPE

Today's landscape in western Victoria is a composite of its geological history and the effects of human activity, both the long-term Aboriginal occupation and the short-term European settlement. The results of the latter are more easily seen, in the small towns and villages, and in the grand homesteads and more modest farm houses, many dating from the nineteenth century, with others reflecting successive waves of land division and closer settlement, particularly in the 1920s and the 40s after each of the world wars.

This built environment includes the ubiquitous stone walls (Fig. 4) and old buildings constructed from the local basalt lava blocks, and the wire-fenced roads and telephone and power lines which, together with the planted windbreaks, dominate the flat plains.

The landscape is rich in heritage. Many archaeological sites have been documented, including middens, painted caves, stone houses, stone rings, and the unique eel traps of the stony rises area near the youthful Mount Eccles volcano (Fig. 7); probably further archaeological features

as well as areas of special significance to the local indigenous people still await official recognition. Historic features such as houses, public buildings, bridges, stone walls and other structures are numerous, and have been documented for the Victorian State Register and the Register of the National Estate. Sites of scientific interest include areas of significant vegetation, especially surviving native grasslands, for which roadside reservations have been listed on the Register of the National Estate. The bandicoots of the Hamilton area are now thriving in a new habitat: the local waste disposal area!

Geological heritage sites include natural outcrops of rock, exposures along rivers and in coastal cliffs, exposures in road and railway cuttings, and landforms such as volcanoes; these also can be valuable lookouts from which to study the landscape (Fig. 10).

Features of geological heritage on the Western Plains, many reflecting the area's volcanic history, have been documented (Joyce & King 1980, Rosengren 1994) and such geological sites, although not always recognised as readily as the more fragile archaeological or biological heritage, can still be a problem to look after and to keep safe from destruction or burial by quarrying or loss in other ways.

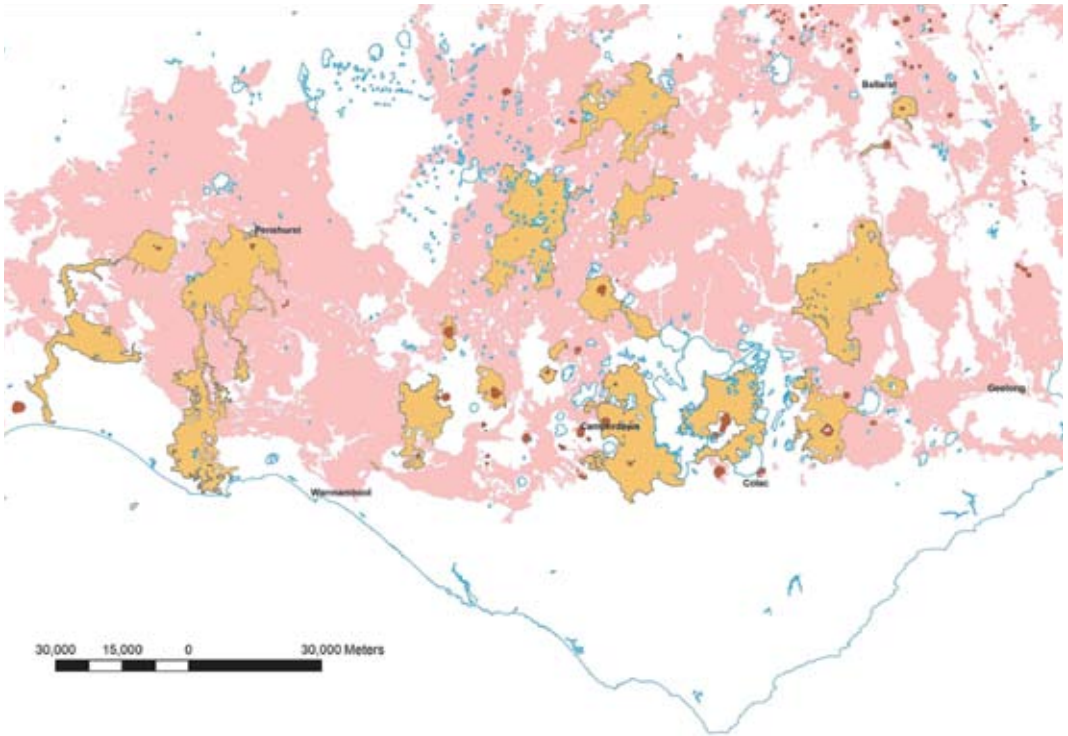
Outcrops and exposures may be built over, or more commonly planted over; this is a particular problem with new road cuttings, which may be specifically designed for battering and grassing-over as part of the road works. Most recently there have been local community moves towards "revegetation" of areas such as national parks and other reserves. Mount Leura volcano is an example of an area where proposed tree planting is so dense that it would obscure the cone and craters and would limit the extensive views of the surrounding volcanic plains, when the available historical evidence suggests that when Europeans first arrived Mount Leura largely carried grass, with only a few scattered trees.

Geological heritage sites need to be maintained in good condition to allow further research, and to be kept accessible to allow their continuing use as teaching sites for schools (both local and from beyond the Plains), and in particular for the training of tertiary students wanting to become geologists or environmental scientists (Ferrett 2005).

Quarrying has been going on in western Victoria for 150 years, providing the characteristic bluestone (basalt) for building houses, farm building and bridges, and crushed rock, scoria and ash for road building.

Near Port Fairy, an old town noted for its historic bluestone buildings, a new industry has been set up on the lava flows from Mount Rouse volcanoes, 65 kilometres to the north. Stone from this exceptionally long lava flow is quarried by the firm Bamstone and is cut and shaped to provide basalt building stone that is being used in many new building projects in Melbourne and exported beyond Victoria and overseas.

Both active and disused quarries provide continuing management problems. Aesthetic problems arise for the community when a quarry is a visible feature in the landscape. Mount Elephant in the central part of western Victoria has been a continuing problem for local residents, the National Trust (Victoria) and the Victorian Division of the Geological Society of Australia. A report commissioned by the two organisations and paid for by the Australian Heritage Commission looked at all the major volcanoes of Victoria and reviewed their significance as a guide to whether scoria or ash quarrying should be carried out (Rosengren 1994). Matching reports by the Geological Survey of Victoria considered the present



Volcanic features of Western Victoria: older weathered lava flows shown in pink, younger Stony Rise lava flows in orange, scoria cone volcanoes in red, and lakes and coastline outlined in blue.

Prepared by Fons VandenBerg, GeoScience Victoria, 2010

and future demands for such quarry materials. At Planning Appeal hearings proposed or renewed quarry leases are now being regularly reviewed and evidence presented to help decide what should be done.

Agroforestry, or tree farming, has recently begun to change the weathered plains grasslands, with plantations, largely blue gum, now established on parts of many farming properties and promising future profits; however, there are fears of the effects on local communities based on an expected decrease in the numbers of farm workers and farming-related activities.

More recently the development of wind farms and the siting of wind turbines are further affecting the landscape.

A new threat is rock crushing, rolling and stone raking of young stony flow surfaces to allow more productive farming, for example on the Register of the National Estate-listed Byaduk valley flow of Mt Napier, south of Hamilton, in 2004, and most recently in the National Trust-classified Stony Rises of Mt Porndon.

References

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Studying the distribution and the geological origin of landscape features on the Western Plains of Victoria enables us to understand both how the region has formed and how it may be continuing to change today. Landscape and landforms (including stony rises), salinity and soils, and past and present climate can be linked to the local environment and to the activities of humans in the landscape both today and in the past.

With proper planning and management, including recognition of the part geology plays in today's landscape, perhaps some aspects of the Arcadian landscape of Mitchell and the early settlers may still be with us in the twenty-first century.

In 2008 the Western Plains between Colac and the border with South Australia, and across to Mt Gambier and Millicent, were designated by UNESCO as the Kanawinka Geopark. Australia's first geopark has been set up to conserve, enhance and promote the geological, volcanic and speleological features of the area, and promote sustainable forms of social and economic development. Heritage and art will play a major role in the new geopark (web reference 2).

Our understanding of the volcanic history of western Victoria over the last five million years allows us to ask if there is still a risk of future volcanic activity (Joyce 2004). A number of writers believe so (Birch 1994, Sutherland 1995), although a lack of high heat flow and low earthquake activity suggest an eruption is not imminent. From our knowledge of the past we can suggest what might happen – a new Mount Napier lava shield and scoria cones, perhaps in far western Victoria, producing a broad spread of lava, and with a long stony rise flow running down a valley towards the sea, or a Mount Gambier maar ash eruption, possibly in the old crater and lake country near Colac and Camperdown.

Birch, W. D. 1994. **Volcanoes in Victoria**, Royal Society of Victoria, 36 pp.

Builth, H. 2010. chapter in this publication.

Corangamite Arts Council, 1995. If These Walls Could Talk: Report of the Corangamite drystone wall conservation project. Corangamite Arts Council, Terang.

Ferrett, Russell. 2005. **Australia's Volcanoes**. Reed New Holland, Sydney, 160 pp.

Joyce, E. B. 1984, "The geology and geomorphology of the Western Plains", in D. Conley and C. Dennis (eds), **The Western Plains – A Natural and Social History**, Australian Institute of Agricultural Science, Parkville, Australia, pp. 1–13.

Joyce, Bernard. 2004. The young volcanic regions of southeastern Australia: early studies, physical volcanology and eruption risk. Proceedings of the Royal Society of Victoria, 116 (1), 1-13.

Joyce, E. B. & King, R.L. 1980, **Geological Features of the National Estate in Victoria. An inventory compiled for the Australian Heritage Commission**, Geological Society of Australia Incorporated, Victorian Division, (x + 208 pp).

Mitchell, T. L., 1838. Three expeditions into the interior of Eastern Australia. T. & W. Boone, London, 2 vols.

Pullin, R. 2010. This volume.

Rosengren, N., 1994. Eruption Points of the Newer Volcanics Province of Victoria. National Trust of Australia (Victoria) & Geological Society of Australia (Victorian Division), 387 pp.

Sutherland, Lin 1995, **The Volcanic Earth**, University of New South Wales Press, Sydney.

Web references

1.
http://www.dpi.vic.gov.au/dpi/vro/portregn.nsf/pages/port_landform_eruption_volcanic
Accessed February 2010

2.
http://kanawinkageopark.com/
Accessed February 2010