The New England North West Regional Plan 2041
Part 2: Geotourism enabling ‘Productive and Innovative’, Objective 7

Proposal

That Objective 7 of the New England North West Regional Plan 2041, as it relates to planning future tourism development, be amended to embrace the concept of geotourism which broadens the scope of potential benefits beyond just agritourism. Geotourism provides the framework to leverage more elements of nature-based tourism whilst enabling the region’s communities to diversify their local economies, leverage their abundant natural resources, increase international and domestic visitation and spend and become a driver of regional and local socio-economic prosperity.

The National Geotourism Strategy

Launched in April 2021 by the Australian Geoscience Council (AGC), the National Geotourism Strategy (NGS) is being implemented to support the orderly development of major geotourism projects and activities in line with overseas trends and domestic regional development imperatives. The development of a National Ecotourism Strategy in 1994 and subsequent state/territory-based initiatives is considered as a particularly useful precedent and guide. Of significance internationally is the development of geotourism in Australia that lags many countries’ approaches, notwithstanding the fact Australia has taken the initiatives in several areas in development of the concepts underpinning geotourism. Further details about the NGS and its seven strategic goals can be referenced at https://www.agc.org.au/geoscience-in-australia/geotourism/

Of particular relevance to the North West Regional Plan 2041, Goal 5 focuses on geotourism opportunities in regional areas that occur outside parks and reserves, but which may contain interesting features and narratives including geological, biological, and cultural elements. Goal 5 is designed to develop geotourism in areas with regional communities (especially past and present mining communities) not covered by significant conservation legislative protections, but which are still worthy of recognition and promotion. It unites a cross-section of representatives from mining groups, Aboriginal heritage and tourism groups, conservation, tourism, and academia to explore tourism potential in places containing geodiversity that:

1. Has been exposed or modified by human activities (especially mining & quarrying).

2. Has significant additional value to people, through cultural history, recreational use, or educational opportunity.

The pursuit of geotourism offers the potential for new industries and employment opportunities through the development of major projects within Australia. Also, very significantly from a strategic perspective, the AGC recognises that the development of geotourism may be one of the best ways to communicate the value of geoscience to the broader Australian community. The AGC considers that this improved profile for geoscience is likely to have a positive impact in other areas of strategic importance, most notably the need for continuing tertiary enrolments in geoscience in key regional places such as the University of New England in Armidale, that is required to meet Australia’s needs for highly qualified geoscience graduates and researchers into the future.

AGC recognises that geotourism is a significant emerging and growing global phenomenon. Geotourism has been defined as:

'Tourism which focuses on an area's geology and landscape as the basis for providing visitor engagement, learning and enjoyment'.

In broad terms, geotourism wholistically embraces adventure tourism, cultural tourism, ecotourism, sustainable tourism and agritourism, but is not synonymous with any of these forms of tourism. This enables experiences within all those segmented product categories to sit under a common framework thereby creating a consistent and integrated approach to all forms of nature-based tourism. For example, ecotourism is practised in protected areas such as national parks whereas geotourism is undertaken in both protected areas and areas here primary industry activities are being carried out.

Geotourism as a driver of place-based Regional Economic Development

Geotourism is increasingly seen globally as an instrument of regional economic development. Many regional Council's in the New England Northwest are embracing a place-based approach to Economic Development, developing wholistic Destination Management Plans as well as regional tourism brands, like New England High Country, working together to align experiences across multiple LGAs. Geotourism in its holistic framework is also 'place-based' in the following ways:

1. Adds considerable content value to traditional nature-based tourism (the primary motivator of travel to Australia) as well as cultural tourism, inclusive of Aboriginal tourism, thus completing the holistic embrace of 'A' (abiotic – landscape and geology) plus 'B' (biotic – flora and fauna) plus 'C' (culture) aspects.
2. Celebrates geoheritage and promotes awareness of and better understanding of the geosciences, noting that a revised global framework for the application of criterion (viii) of the World Heritage Convention as it applies to World Geological Heritage has recently been released by the IUCN https://portals.iucn.org/library/sites/library/files/documents/2021-025-En.pdf .
3. Contributes to regional development imperatives in areas experiencing social and economic difficulties through increased tourist visitation, particularly from overseas – of increasing interest to local government agencies (LGAs) and state based, regional development commissions and agencies.
4. Provides a means of highlighting and promoting public interest in mining heritage including gemstone and gold fossicking as well as the emerging interest in rare earth minerals.
5. Provides the means of increasing public access to geological information through a range of new interactive digital applications on smartphones that enable advanced and innovative ways of experiencing nature, for example, augmented reality, Soundtrails and 3D visualisations.
6. Engenders an increasing awareness of the importance in geology as a fundamental science that has had and will continue to have major impacts on civilisations;
7. Promotes tourism through visits to geological features (geosites), use of geotrails and viewpoints, guided tours, geo-activities (such as geological time trails, fossil walks, rock gardens, rail trails, skywalks etc.), and patronage of local visitor centres and museums;
8. Encourages attractions to be developed as a sustainable tool for the growth of local and regional communities.
9. Offers the potential for new industries and employment opportunities through the development of major projects within Australia.

Key benefits of Geotourism development

The benefits of geotourism development in Australia are many including:

1. **Tourism Industry** development benefits in the context of addressing the current COVID-19 pandemic can be realised through the holistic approach of geotourism which enhances the value of traditionally structured, nature-based tourism by generating new product development (i.e., including geology, landscape, flora and fauna, as well as cultural heritage attributes, both Aboriginal and post European settlement).

2. **Employment benefits** through the adoption of a strategy to support and promote geotourism include the following, all of which have the potential to significantly improve indigenous employment, and more broadly, regional employment:

    - New domestic employment and consulting opportunities for natural/cultural heritage professionals, design of interpretation signage/boards, design of geotrails and 'geotales';
    - Management roles in geoparks and mining parks, regional development, and local government agencies supporting the visitor economy.
    - Direct employment opportunities in tour operations resulting from increased tourism visitation.
    - Opportunities for pastoralists to value-add and diversify by developing 'farm stay' and 'station stay' tourism experiences.
    - Creating indirect multiplier effects across other industries to service the additional visitation.

3. **Societal benefits** for local communities, particularly in rural and regional Australia, include the following:

    - A mechanism for celebrating and raising awareness of mining heritage, past and present.
    - An opportunity to enhance community engagement and build value into Environmental, Social, and Governance (ESG) considerations.
    - By celebrating geological heritage, and in connection with all other aspects of the area's natural and cultural heritage (and most significantly, Aboriginal heritage), geotourism enhances awareness and understanding of key issues facing society, such as using our Earth's resources sustainably.
    - By raising awareness of the importance of the area's geological heritage in society today, geotourism gives local people a sense of pride in their region and strengthens their identification with the area.
    - The strategy acknowledges the need to protect the scientific and cultural sensitivity of some geoheritage and geosites, and to ensure protection from geotourism where appropriate.
    - Education opportunities and early employment experience for school-age children who are more sensitive to protecting and nurturing our environment.

In summary, the over-riding socio-economic benefits of geotourism are measurable economic outcomes through the enhancement of traditional nature-based tourism resulting in additional day and over-night visitors, increase visitor spend, direct and indirect regional economic output, household income and wages, and local (including Aboriginal) employment.

Delivering Geotourism products and experiences

Geotourism can be readily delivered through the development of both geotrails and geoparks within identified 'GeoRegions'.

1. Geotrails

A geotrail can deliver geotourism experiences through a journey underpinned by an area's geology and landscape. Geotrails are therefore best constructed around routes currently used by tourists i.e., geotrails should form logical journeys linking accommodation destinations.

Geotrails can comprise roads, walking and biking trails, and disused railway easements.
Geotrails should meld the geological heritage features of a region with a cohesive story and should incorporate and package in the biodiversity and cultural components (including mining heritage) of the region through which the geotrail traverses. Geotrails do offer the advantages of having universal appeal, and do not compete with or impact on land management/access issues. They are easy to establish and represent a very cost-effective means of enhancing regional development.

They are also an effective vehicle for promoting broader community interest in Geoscience and recognition of it as one of the four fundamental sciences along with Physics, Chemistry and Biology. As such there are long-term educational and cultural benefits in fostering the appreciation of how our Earth influences landscape, ecology, and our lifestyles.

Western Australia's Mid-West Development Commission (MWDC) is working with seven shire councils to establish WA's first major geotourism development to be built on a geotrail model, focused on the Murchison 'GeoRegion' of WA. The MWDC believes that the ancient Murchison geology and mining heritage provides the ideal platform for unique, nature-based tourism experiences of global significance, particularly to the 'experience seeker / dedicated discoverer' market. The Mid West Tourism Development Strategy (2014) concluded that the region's iconic nature-based tourist attractions were not developed to their potential and that its visitor appeal was not fully realised. The Strategy identified geotourism in the Murchison 'GeoRegion' as a potential 'game changing' tourism initiative, with capacity to help this 'GeoRegion' realise its potential as a major tourism destination.

2. Geoparks

Geotourism attractions are now being developed around the world primarily as a sustainable development tool for the development of local and regional communities. A major vehicle for such development is through the concept of geoparks. A geopark is a unified area with geological heritage of particular significance and where that heritage is being used to promote the sustainable development of the local communities who live there.

Unlike World Heritage Areas and national parks, geoparks can embrace both protected and any resource extraction areas, focusing on sustainable development objectives. Geoparks also focus on community engagement and ownership. In Australia, national parks focus generally on biodiversity and often with insufficient attention given to geological heritage.

UNESCO Global Geoparks are single, unified geographical areas where sites and landscapes of international geological significance are managed with a holistic concept of protection, education, and sustainable development. Whilst World Heritage Areas and national parks are created in perpetuity, the status of global geoparks are reviewed by UNESCO every four years.

Whilst a geopark must demonstrate geological heritage of particular significance, the purpose of a geopark is to explore, develop and celebrate the links between that geological heritage and all other aspects of the area's natural, cultural, and intangible heritages. It is about reconnecting human society at all levels to the planet we all call home and to celebrate how our planet and its 4,600-million-year long history has shaped every aspect of our lives and our societies. Geoparks are both a regional development concept as well as a branding tool. They achieve these goals through conservation, education and geotourism. Geoparks can comprise both protected and non-protected areas and enable and celebrate sustainable development of primary industries such as mining, agriculture, and forestry.

Geoparks can choose to evolve through a series of levels from 'aspiring', 'national', 'regional' (e.g., European or Asia-Pacific Regions) to 'global'. There are now hundreds of geoparks around the world. Support to individual geoparks is offered through the Global Geoparks Network Bureau which is currently representing 169 members from 44 countries. The original target of the Global Geoparks Network is establishing 500 geoparks around the world. The number is growing at a rate of about 10 new global geoparks per year.

3. GeoRegions

A 'GeoRegion' can be considered a defined area of natural and cultural heritage which highlights outstanding geoheritage features. Adopting this initial approach offers the opportunity for proponents using the language of 'GeoRegions' to explore various alternative options for geotourism development, including a strong focus on the establishment of geotrails between sites of geological merit as interpretive sites, including robust geoheritage sites, some of which may already have been established as geological 'monuments' or recognised in state or national geoheritage registers. As a first step, a full audit of natural and cultural heritage attributes in the region as well as early discussions with state/territory based Geological Surveys, Planning and Environment agencies, and any other state/territory government agencies responsible for land and resource management is recommended.

Elsewhere in NSW, the Friends of Ku-ring-gai Environment Inc, a community-based organisation, has initiated a project with the objective of making a positive contribution to conservation based in and around Ku-ring-gai Chase National Park, located on the northern outskirts of Sydney by seeking recognition of the very significant natural and cultural heritage values as exemplified by a wide range of geosites that exist in this 'GeoRegion'. This is not unprecedented in New South Wales as other geosites and geotrails have similarly been recognised at Port Macquarie, Newcastle, Warrumbungle National Park, Central Darling River region and Mutawintji National Park.

Having conferred with a range of experts on the geology, geomorphology, and related natural and cultural heritage values of Ku-ring-Gai Chase National Park, it was decided, within the framework of the NGS, to investigate further particularly the special geoheritage values which exist in the proximity to the Ku-ring-gai Chase National Park area. These geoheritage values (both geomorphological and geological) form the platform for the development of the other natural heritage attributes as well as demonstrating the close relationship between landscape and human activity over many thousands of years. The Geological Survey of NSW (GSNSW) has advised that, while concerned that appropriate steps will need to be taken by three LGAs (i.e., Ku-ring-gai, Hornsby, and the Northern Beaches) as well as the NSW National Parks and Wildlife Service (NPWS) to ensure that visitor impacts are properly managed, the GSNSW has no objection to any proposal to develop this 'GeoRegion' embracing some 250 square kilometres in area as an Aspiring UNESCO Global Geopark.

A Proposed Glen Innes Highlands 'GeoRegion'

Within the framework of the NGS and as a significant first for Australia, the Glen Innes Severn Council has recently approved a comprehensive Tourism Destination Management Plan https://lnkd.in/g5yk5aNu that has embraced 'geotourism as a holistic approach to featuring natural and cultural heritage into the relevant customer experiences.' The Plan also proposes the development of various trails including the funded New England Rail Trail Stage 1 from Glen Innes to Ben Lomond, the funded Glen Innes Highlands Skywalk, mining geotrails and 'geotales' that tell the story of the formation of the east coast of Australia and the Gondwana continent.

In addition, the Council has decided to investigate the potential of the Glen Innes Highlands being developed as an outstanding 'GeoRegion' and to review the NGS, with the intention of approaching the AGC to conduct an audit of this proposition, with early input anticipated from the GSNSW and from other geoscientists with local knowledge and experience.

The Council also sees the medium-term potential of this proposed 'GeoRegion' being considered as a potential Aspiring UNESCO Global Geopark nomination, given the diversity of the New England North West Region's substantive cultural attributes including its rich mining heritage.

Significantly, Austrade has advised the AGC that it will be highlighting the Glen Innes Highlands as a case study of geotourism in their final report to Government, National visitor economy strategy: THRIVE 2030, 'a national strategy for Australia's visitor economy recovery and return to sustainable growth – 2022-2030'.

A Proposed New England North West 'GeoRegion'

The AGC recognises and supports the views of Council that based on geological and mineral province considerations, the currently identified 'GeoRegion' could well be expanded to include other areas within the New England North West region.

The AGC accepts that this proposition is worthy of further discussion with the GSNSW and as part of any further investigation with the NPWS and the University of New England.

To assist in this regard, a copy of the report by Dr K G McQueen to the GSNSW, that details the extensive mining history of New England North West, is attached (refer Appendix) as an informative reference document. Dr Phil Blevin of the GSNSW can also provide up to date information about the geology and geomorphology of the New England North West. Contact: phil.blevin@planning.nsw.gov.au

Margot Davis, Manager Economic Development, Glen Innes Severn council can be contacted in relation to a draft International Attraction Strategy that has been created to guide the process of developing 'georegions' and an Aspiring UNESCO Global Geopark for the New England Highlands.

It is further proposed that any expanded 'GeoRegion' be embraced and supported through the strategies available through the implementation of the NGS.

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Appendix

Mining history of the New England Region

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A wide range of commodities has been mined in the New England region, reflecting a diversity of mineral deposit types. Major production has been of gold, tin and antimony, with lesser production of silver, lead, copper, molybdenum, tungsten, bismuth, gemstones and industrial minerals. Early mineral discoveries, led by gold, were in the more accessible and settled areas on the tableland and up the rivers. Later, prospectors fanned out into the rugged and forested escarpment areas. Much of the gold and most of the tin production came from alluvial deposits concentrated during weathering and extensive erosion of small or low-grade primary mineralisation associated with the widespread granites.

Gold

Gold discovery in New England was prompted by the first gold rushes to the Bathurst area of central New South Wales in the autumn of 1851. Fearing loss of business from an exodus to these diggings, reward committees were set up by local businessmen to promote the discovery of gold in the Hunter River and New England areas. In September 1851 gold was discovered and worked at Swamp Oak Creek, a tributary of the Peel River 24 km east of Tamworth. Other finds soon followed along the Peel, McDonald and Rocky Rivers, with prospectors W.F. Buchanan and J. Lucas prominent in these early discoveries.[1] In February 1852, Edward Hargraves was persuaded to visit New England and submitted a cursory, inconclusive report.2 Geologist, Rev. W.B. Clarke also visited the region and reported on the geology and mineral occurrences during his exploration of the northern goldfields between late 1852 and early 1853.[3]

The earliest gold fields worked on a payable scale were at Hanging Rock, the Peel River and Bingara.[4] As in many areas, initial interest was in shallow alluvial mining, followed by the working of deep leads and reef deposits. Gold production, particularly from Rocky River and later Hillgrove, brought much wealth to Armidale the nearest major town and many of the fine historic buildings in this city date to the gold rush era.

Nundle-Peel River

The gold discovery at Swamp Oak Creek led prospectors to other alluvial deposits along the Peel River catchment, including in the present drainage, high-level terraces and old valley leads buried by basalt lava flows. Part of this land was held by the Australian Agricultural Company, which became involved in mining with limited success.[5] The main mining centres developed around Nundle, Hanging Rock and Bowling Alley Point. The alluvial deposits were largely worked out by 1890, but some were reworked by dredging during 1907-1914. Numerous, small quartz-reef gold deposits were also found and some of these had rich patches of near-surface, secondary gold, but most production was of alluvial gold.[6] Total production from the field is estimated at about 10 t.[7]

Rocky River (Uralla)

Gold was discovered at Rocky River, 18 km southwest of Armidale, by William Buchanan and James Lucas in September 1851.[8] Further discoveries, particularly by the Windeyer brothers led to the development of a major alluvial field from November 1852.[9]

The initial diggings were along the course of the river and tributaries and for three years these shallow deposits were worked extensively over 7.6 km. Most early miners were very successful, commonly making about 2 oz per man per day, but by the beginning of 1853 yields had decreased and miners began leaving the field. At the end of the year production improved following the introduction of more efficient machinery, including pumps, and more than 500 miners were at work. [10]

In February 1856 the first gold-bearing deep lead was found to the east of Rocky River, when Thomas Jones, or possibly his wife, saw gold specks in a cartwheel rut in sand on a hill, subsequently named Mount Jones. In May another buried deep lead was found beneath Mount Welsh, and shortly after at mounts Harris, Brisbane, Beef, Mutton and Marsh and at Tipperary Hill, Doherty Hill and Sydney Flat. These deep leads beneath 'Tertiary' (Neogene-Palaeogene) basalt flows were much richer than the Quaternary alluvial deposits and led to a major revival in the Rocky River field. In the five years from 1856 to 1860, 120 000 oz of gold (3 732 kg) were produced, mostly from deep lead mining. The population of the field peaked at 3500, including 2500 miners, near the end of 1856. From 1857 parties of Chinese miners began arriving at Rocky River and they contributed significantly to the later production from the field.[11]

Gold production declined in the early 1860s, but increased following the introduction of new methods, particularly tunnelling along the deep leads by companies, rather than the inefficient sinking of multiple shafts. In 1876, the Long Tunnel Company began an 800 m drive to drain water and gain access to some of the unworked deep lead gold, the work extending over eight years.[12]

By 1896 the accessible alluvial gold at Rocky River had been largely worked out, but from the early 1900s there was interest in reworking the old diggings with mechanical dredges.[13] During 1911-1914 the Uralla Gold Dredging Company Ltd successfully worked part of the river near Maitland Point with a pump dredge, producing 4145 oz of gold. Smaller scale dredging by a number of groups from 1929-1932 produced an additional 721 oz.[14]

Lode gold deposits were found in the granite around the Rocky River field and worked from the 1890s. These included the Goldsworth Mine, Little Gracie, Martins Mine and Frasers Find.[15] Historic production from these bedrock deposits was small (ca. 30 kg), but recently there has been renewed interest in exploring the region for larger, low-grade intrusion related gold deposits. Total estimated gold production from the Rocky River goldfield is at least 4.3t and was mostly from the deep leads.[16]

Timbarra (New Rocky River)

Gold was discovered on the Timbarra River, 33 km east of Tenterfield, in 1853. However, it was not until 1856 that significant mining developed when rich alluvial deposits were found along McLeods Creek, a northern tributary.[17] This site is on the edge of the New England tableland and a settlement known as Timbarra-Tableland was established near the head of the creek. Prospectors rapidly tested the precipitous Timbarra valley and found fine-grained alluvial gold along much of its course and tributaries.[18] In May 1859 the Timbarra River from McLeods Creek to the Clarence River was proclaimed a gold field.[19] Being relatively remote, news from the field was scant and its extent was not widely known. Many of the early miners did very well, although commonly sluicing operations were restricted to three months of the year due to lack of water. The alluvial workings were also disrupted by periodic flooding. At the end of 1859 the population of the field was around 2500, but the township had only reached three hotels, several stores and a short-lived bank, due to the reluctance of storekeepers to shift to the area.[20] From mid-1859 numerous Chinese miners began arriving at the field, many coming from the Mudgee area and Rocky River goldfield. In 1869 a group of Chinese transferred from Sofala to work the bed of the Timbarra River during dry conditions and to also rework some of the older diggings.[21]

During the 1850s gold was also found on a high granite spur on the western side of the Timbarra River about 10 km south of McLeods Creek. An Italian prospector, Paulo Marcolini, claimed to have discovered the gold here, but could not make it pay, later setting up a bakery on the site instead.[22] The gold occurred over a wide area in the shallow surface soil and underlying weathered granite, however being at such a high elevation it was difficult to obtain water for alluvial sluicing. The location became known as Poverty Point, although it was later found to contain significant gold. Similar gold-bearing granite was found 4 km to the west at Surface Hill where the soil and decomposed granite were worked to a depth of 10 m.[23] Initially, the surface material was excavated and sluiced to extract the gold with later hard-rock mining of mineralised zones in the granite and related dykes. In 1880 the Surface Hill Sluicing Company spent £10 000 constructing an 800m tunnel and iron flume to bring water to work the area. In 1886 this company was reformed as the Surface Hill Gold-crushing Company to set up crushing equipment and an amalgamation plant to process the weathered granite as only about half the gold could be extracted by simple washing.[24] This venture had limited success due to the refractory nature of the primary ore and in 1899 the leases were let out on tribute.[25] A new company, the Surface Hill Gold Mining Co., was formed in 1907 and additional equipment installed, including a cyanide plant. This group also had limited success and work was suspended in 1909 with a plan to increase capital and improve the plant.[26]

Most mining activity on the Timbarra field ceased by 1915, although fossicking continued and there were minor intermittent revivals up until 1938. From 1969 there was renewed interest and exploration for large, low-grade gold deposits hosted by the local granite. In 1997 Ross Mining Ltd defined a resource of 327 700 oz of gold grading 1.2 g/t at Poverty Point and Big Hill. This was gold disseminated through greisenised granite, suitable for shallow open pit mining and heap-leach processing.[27] Total gold production for the Timbarra field is unknown but exceeds 3.1 t.[28]

Tooloom-Pretty Gully

Gold was discovered at Tooloom Creek in the northern Clarence River catchment by William May, possibly as early as 1857.[29] At first there was little publicity, but by mid-1859 a sizeable rush had set in.[30] Near the end of the year the population of the field was almost 1000 and another area of rich alluvial gold had been found nearby at Pretty Gully.[31] On the 15th of December a 140 oz nugget was found on the Tooloom diggings by James Templeton and George Boyes and named the 'Lady Bowen'. Although numerous small nuggets had already been found and miners were making good returns, many recovering 3-4 oz per week, this find stirred additional interest.[32] There was close communication between the Timbarra and Tooloom diggings and miners often moved between the two. There was also a strong connection to southern Queensland with much of the gold from Tooloom and Pretty Gully taken by escort to Ipswich and the coffers of the Queensland Colonial Government in Brisbane.

Alluvial mining in the Tooloom region declined from 1870, when many of the miners joined the rush to Gympie in southern Queensland. From this period there was minor reef mining, particularly in the 1890s.[33] More recent exploration from the 1990s, focussed on exploring for larger, low-grade intrusion related and shear-hosted gold deposits.[34]

Hillgrove

Antimony was noted at Gara, east of Armidale, by W.B. Clarke in May 1853 and minor alluvial gold was found along Bakers Creek as early as June 1857.[35] Mineable deposits of stibnite (antimony sulphide) were discovered on the west side of Bakers Creek gorge and worked on a small scale from 1877.[36] It was not until 1881 that gold was found to be associated with the stibnite at the Garibaldi Reef. At first there was limited interest in the gold because of the difficulty of separating it from the antimony, but in March 1887 George Smith discovered a gold-rich reef exposed in a gully on the edge of Bakers Creek at the bottom of the gorge. This became known as the Big Reef and subsequent discovery of the Little (later renamed Smith's) Reef and other nearby gold-bearing veins sparked a gold rush to Hillgrove.[37] By 1889 there were more than 30 separate mining leases on the field.[38]

The Big and Smith's reefs were initially worked as 'The Four Brothers' mine and over four months, six men were able to produce gold worth £2500 with the aid of a primitive spring dolly. W.B. Neales from Adelaide joined the syndicate with a one fifth share in return for a 5-head stamp battery, following which the Baker's Creek Gold-Mining Company was floated with a nominal capital of £100 000.[39] Within a year the company had paid £72 000 in dividends and it went on to become the most successful on the field.[40] Being in a 460 m deep gorge, access to the Bakers Creek mine was difficult, so in 1889 the company constructed an inclined tramway from the top of the gorge to its plant and three tunnels near the bottom. The main use of the tramway was to supply wood for the steam engines.41

Other successful gold-producing mines included the Eleanora, Lady Carrington, Cosmopolitan, Sunlight, West Sunlight, Garibaldi and Golden Gate. South Australians were prominent investors in Hillgrove mining field, including the Bakers Creek Gold-Mining Company, which had a large shareholding by Adelaide capitalists who had made money in the Broken Hill mines.[42] Gold production from Hillgrove peaked in 1896 at 37 852 oz making it the largest producing gold field in NSW for that year.[43] However, the cost of accessing and supplying the workings in the difficult terrain, the increasing depth of the workings and the cost of processing the complex ores reduced profitability, and by 1912 mining was in marked decline.

Following the initial gold rush, the small Eleanora Township, named after one of the early antimony mines, quickly expanded as the town of Hillgrove, surveyed in 1888. By 1890 the population had reached over 2000 and the town had the full array of trades and businesses including six hotels, three hairdressers, two newspapers and an oyster saloon. It also featured a public school, school of arts, cottage hospital, post and telegraph office and police station. In 1888 the Mining Warden's Court was moved from Armidale to Hillgrove.[44] In 1894 Hillgrove received electric lighting when a hydroelectric plant was built at Gara Falls to supply the mines and the town. This was later extended with a second plant on the Styx River.[45] Hillgrove's proximity to Armidale meant that it did not grow even larger or maintain its size as mining declined after 1912.

In 1921 the famous Bakers Creek mine closed marking the end of the early gold mining phase. In the following years there was small-scale prospecting and mining and in 1937 the Bakers Creek mine was reopened and worked for several years. Also, in the late 1930s until the 1950s significant scheelite was mined at the Dammed If I Know mine, providing much needed tungsten during World War II. Modern mining commenced at Hillgrove in 1969 with New England Antimony Mines N.L. working the historic Eleanora-Garibaldi and Freehold mines. The initial focus was on antimony, but as the price of gold dramatically increased in the 1980s attention turned again to gold, with production continuing up to 2001.[46] In March 2004 Straits Resources purchased the Hillgrove gold project and mining recommenced periodically up until 2015 when Straits sold out to Meridian Capital, a Hong Kong based company.[47] Historic production from the Hillgrove mines is estimated at >22.39 t of gold, >50 000t of stibnite and >2000 t scheelite.[48]

Smaller goldfields

Numerous smaller goldfields with recorded production less than about one tonne of gold have been worked across the New England tableland and in the rugged eastern escarpment. The latter include the Dalmorton, Solferino-Lionsville and Orara-Coramba fields west, northwest and south of Grafton, discovered in 1866, 1871 and 1881 respectively.

Tin

The earliest discovery of tin in the New England region is shrouded in mystery. In 1873, James Daw claimed he had found tin on a tributary of the Severn River in 1849 and to have made other later discoveries.[49] The ubiquitous W.B. Clarke reported the occurrence of alluvial tin with gemstones in the catchment of the Macintyre River during his exploration of the northern goldfields in 1853.[50] These and other early discoveries were not followed up until 1871-1872 when large exploitable deposits of cassiterite (tin oxide) were discovered at Elsmore, Oban, Tingha, Vegetable Creek and Stannifer. Working of these and other tin deposits in Tasmania and north Queensland made Australia the largest tin producing region of the world in the 1870s and 1880s.

Tin discovery and mining followed a pattern similar to that of gold, with initial interest in shallow alluvial deposits in the present drainage, followed by the working of older leads and deep leads, some buried beneath basalt lava flows. As the industry matured, capital intensive mining of lode deposits and large-scale dredging developed. Similar to gold, tin mining brought new wealth and development to the surrounding towns, including Glen Innes and Inverell, as well as creating new towns such as Emmaville, Tingha and Stanthorpe.

An interesting aspect of tin mining in New England was the involvement of large numbers of Chinese miners, many of whom had previously worked on the alluvial goldfields. Their skills in the efficient use of water and team organisation meant that they were able to profitably work much of the lower grade ground.[51] Between 1877 and 1890 more than 3000 Chinese were at work on the New England tin fields.[52]

Elsmore-Inverell

The story of discovery and working of tin at Elsmore, 15 km east of Inverell, is a veritable romance of mining. The initial discovery was by Joseph Wills, an eccentric shepherd on Newstead Station. Over some time, he collected samples of heavy black cassiterite, apparently not realising its true nature or value. However, he was able to sell some to a curious commercial traveller in an Inverell hotel for a few shillings and through this means it was brought to the attention of Cornelius McGlew. McGlew had some knowledge and interest in tin prospecting and in early 1871 travelled to Armidale to collect more information on the whereabouts of the shepherd, before proceeding to Newstead. Wills took McGlew to the site of an old saw pit and showed him cassiterite exposed on the surface where the disturbed soil had been washed by rain. McGlew collected samples and returned to Sydney. He subsequently returned to Elsmore with Joseph Barron and in two weeks during June-July 1871 washed out 2903kg of tin ore in a small sluice box. The site was on land previously offered for auction at Inverell in July 1861 but had not sold. Barron in partnership with Alexander Brown and Solon Sinclair applied to purchase the land at the reserve price and it was alienated to them by Crown Grant in February 1872. Additional Mineral Conditional Purchase claims were also taken out by Brown, Barron and others.[53] This was the start of the Elsmore tin mine, which drew great interest, and together with a higher tin price in the early 1870s,[54] sparked a tin rush to New England.

The Elsmore Tin-mining Company Ltd was set up in late 1871 to develop the extensive leases. Initially the shallow tin-bearing colluvium was carted to the nearby McKintyre River and washed in sluice boxes. This proved inefficient, so a large dam was constructed on Elsmore Hill and water pumped up from the river to allow large-scale ground sluicing. Much of the tin at Elsmore was colluvial or eluvial, occurring directly above or in the decomposed host granite. Two alluvial leads were found to extend off Elsmore Hill, partly buried beneath younger basalt. As ground sluicing continued rich tin lodes and veins were exposed in the bedrock beneath the colluvial and alluvial cover and attempts were made to work these from shafts and shallow pits. This also prompted the erection of crushing and ore dressing equipment in October 1872. When Archibald Liversidge reported on the mine in July 1873, the operation included both alluvial and lode workings, two steam pumps, boilers, sluicing equipment, a puddler to break up some of the cemented alluvial material, 20 head stamp battery, gravity separators and a sawmill. With a workforce of about 50 men the alluvial workings were producing 15 t of tin concentrate per month.[55] At first the concentrate was exported to England, but later it was smelted in Sydney.

Other companies set up around Elsmore as additional discoveries were made. These included the Karaula Tin Mining Company, New Cornwall, Newstead Tin Mining Company and Newstead Byron Tin Company.[56] The initial tin boom began to fade in the mid to late 1870s with a declining tin price.[57] A revival in the tin price saw the Elsmore property acquired by the Union Tin Mining Company in 1882 and operated by them up to 1889, after which the alluvials were worked on a small scale by tributers.[58] Renewed interest followed a sharp rise in the tin price at the turn of the century and the introduction of new technology. In 1900, Brown Brothers, Cooper and Co. installed new pumping equipment at Elsmore and their interests were then transferred to the newly formed Elsmore Tin Sluicing Company NL, which worked alluvial tin until 1921. Other groups conducted prospecting and intermittent mining, including some modern exploration by Malachite Resources Ltd since 2004.[59]

Stanthorpe

After initiating tin mining at Elsmore, Cornelius McGlew in February 1872, followed up a clue that led to the discovery of tin at Quart Pot Creek across the border in Queensland. Police Magistrate G.W.F. Addison mentioned that he remembered a very heavy sandbag used as a wind break at the Quart Pot Hotel. With partner Dennis Eisenstaedter, McGlew travelled to the locality and determined the source of the sand was the adjacent creek bed, where they discovered rich tin. This led to the development of a new tin field and the foundation of Stanthorpe.[60]

Tingha-Stannifer

Stream tin had been noticed as heavy black sand in some gold-bearing alluvium from the 1850s, including at Oban where it was considered worse than a nuisance during separation of the gold. At Captain Swinton's station the stockmen used the granular stream tin from Copes Creek to clean the bits of their horses' bridles.[61] Following the stir created by the discovery of exploitable tin at Elsmore many of these sites were investigated and by early 1872 a large number of new tin fields were developed.

The first alluvial mining at Copes Creek was by George Fearby in March 1872.[62] He had noticed cassiterite in wheel ruts along a road about 200m from a crossing of the creek and found good prospects in the nearby gravels. The site proved fabulously rich, and Copes Creek was soon crowded with other prospectors and miners, many of whom had been on the Rocky River gold diggings.[63] As mining progressed, numerous deep leads were found as well as many bedrock lodes, however the latter were generally too small to be profitably mined. By the end of 1872 a settlement had developed near Copes Creek and took the name Tingha, after the Tiengah sheep run.[64]

Alluvial mining declined between 1893 and 1901 but was revived with the installation of a large hydraulic dredge on Copes Creek in March 1901 by the Copes Creek Dredging Company NL.[65] Based on the concept of large alluvial gold dredges first developed in New Zealand, the new technology allowed efficient working of low-grade alluvium and previously worked ground. The success of this operation led to the introduction of large-scale hydraulic and bucket dredging across the tin fields, which continued until the 1970s.

Up to 1972, 70 000 t of cassiterite concentrate had been produced from the Tingha area.[66]

Emmaville-Torrington

Alluvial tin was found near the source of Vegetable Creek by Thomas Carlean, a piano tuner, in March 1872.[67] Early mining was focussed on a shallow lead in the swampy valley, but later the Vegetable Creek deep lead was discovered to the west. This deep lead system extended for 8 km under basalt cover, typically about 40m thick, and was worked from shafts and underground drives and later, by open-cut mining. The Great Britain Tin-mining Company and Vegetable Creek Tin-mining Company were two of the early successful miners. Other deep leads were soon found, and traced under the basalt, including the Rose Valley, Graveyard, The Springs, Rocky Creek and Ruby Hill. By the end of 1873, 2,345 t of tin ore had been extracted from the shallow gravels and 247 t from the deep leads, however by 1881 the deep leads were the major source of tin.[68]

In 1875 John Moffat, who had established a store at Stanthorpe in 1872, built a tin smelter with partner Thomas Harridge at Tent Hill, near Vegetable Creek, to treat the ores close to the tin fields.[69] At first this was not a financial success due to metallurgical problems and the low tin price, but in 1876 the operation was restructured as the Glen Tin-smelting Company with John Reid as manager. The plant was expanded to include a battery for treating lode tin as well as toll smelting of alluvial tin. By 1887 more than 2000 t of tin ore were being treated annually by the Glen Smelting Works at a saving of 30% to the smelting cost.[70] Moffat later went on to greater success and fame on the north Queensland tin and copper fields of Herberton and Chillagoe.[71]

Chinese miners began arriving at Vegetable Creek from Copes Creek, Stanthorpe and directly from China in large numbers in 1877. This was facilitated by the difficulty for the European miners of working poorer ground under conditions of drought and a low tin price.[72] In 1880 the settlement of Vegetable Creek was renamed Emmaville and by this time had a population of 2100, including 1200 Chinese.[73]
Bedrock tin lodes were discovered in 1874 and the first crushing machinery introduced. North of Emmaville over 150 mineral deposits were discovered within, and around the Torrington roof pendant above the Mole Granite. These deposits contain varying tin, tungsten, silver, arsenic, bismuth, base metals, fluorite, beryl and molybdenum.[74] Most are small, but important mines included the Ottery mine near Tent Hill, Buttler lodes and Webbs silver lode. High tin prices from the 1960s to the early 1980s reawakened interest in tin and led to further alluvial mining and working of the Great Britain stockwork deposit outside Emmaville.

The Emmaville-Torrington area is one of the most intensely mineralised regions in Australia, with a fascinating mining heritage. For these reasons the area is a drawcard for fossickers and tourists.

Antimony

The Hillgrove antimony-gold veins have been the major source of antimony in New England with total recorded production of >50 000 t. Other mines include Wild Cattle Creek, which was first prospected in 1890 and redeveloped during 1972-1974 to produce $235 000 worth of antimony. The Magwood mine northeast of Hillgrove produced over 3400t of antimony and deposits in the Taylors Arm area about 600 t.[75]
Antimony mining began east of Armidale in 1877 with discovery of a payable lode by the Havershed brothers. A parcel of 4.9 t mined from the outcrop was taken to Grafton by bullock dray and then shipped to England for a return of £17 15s.[76] In 1878, local farmer John Bracken discovered stibnite along the eastern rim of the Bakers Creek gorge.[77] This discovery led to development of the Eleanora mine and other deposits, particularly after 1882 when gold was processed from the ores and the price of antimony took an upswing (see above under Gold).

Silver

Boorook

The Boorook area, east of Tenterfield, was prospected for gold from about 1870 with some payable ore produced from the near-surface zones of several reefs. However, gold grades decreased with depth and miners abandoned the site when tin was discovered in the district. In early 1878, Thomas Horton reinvestigated the Golden Age mine and discovered the ore contained high levels of silver, leading to a silver rush to Boorook.[78] By 1879, 50 mining leases had been taken out and a small settlement of 300 people developed at Boorook.[79]

Horton and his associates, funded by the Glen Tin-smelting Company, worked the Golden Age mine for several years employing a crude processing plant with stamp battery and amalgamating Berdan pans. This was the first payable silver mining operation in New South Wales, which also prompted the first significant investigations into appropriate silver processing methods.[80] The property was progressively purchased by J.W. Hall and Co., which in 1881 constructed roasting and chlorinising furnaces on the Cataract River, about 2.5 km from the mine, for improved recovery of silver.[81] Mining and silver production continued up to 1886.[82]

The main producing mines at Boorook were the Golden Age, Addison and Silver King. At the Golden age much of the ore graded 60-350 oz/t silver, with some rich patches up to 800 oz/t.[83] The Boorook deposits were worked to a maximum depth of 100 m, for a total recorded production of 3.58 t of silver.[84]

Drake (Fairfield)

The gold-bearing Adeline reef at Drake was discovered in March 1886 by Samuel Costa, a travelling hawker who camped one night at the eastern end of town and arriving early spent some time prospecting.[85] This discovery was relatively late given the surrounding discoveries at Timbarra, Tooloom, Pretty Gully and Lunatic, but it led to further discoveries on Mount Carrington, just north of the town, and further afield at White Rock, Mascotte, Lady Jersey and Red Rock.[86] Similar to Boorrook, the deposits at Drake are polymetallic, containing copper, gold, silver, lead and zinc. Although the early interest was in gold, the field became an important producer of silver and copper. Many of the mines were initially very successful, working near-surface secondary mineralisation, but at depth the complex nature of the ores resulted in metallurgical difficulties.

More recently there has been significant exploration and some mining in the Drake area using modern techniques. During 1969-1972 about 10 000 t of mixed sulphide ore were mined at Emu Creek and Red Rock by Mount Carrington Mines Ltd.[87] Between 1988 and 1990, approximately 233 000 t of ore grading 2.38 g/t gold and 7.44g/t silver were mined by open cut in the Mount Carrington area.[88] Total production from the Drake area included about 2.5 t of gold and more than 4.4 t of silver.[89]

Silver Spur (Texas)

The Silver Spur mine, 10 km east of Texas in southern Queensland, was developed from 1892.[90] The deposit was discovered in 1891 when farm workers, John White and Jack Hill were splitting fence posts on a low hill on Gunyan Station. A branch from a felled tree penetrated the ground and exposed gossan with green malachite, similar to that at the nearby Texas copper mines.[91] John White showed samples to the copper miners who though they looked promising. A small syndicate was formed and an exploration shaft sunk but abandoned when little copper was found. In October 1892, John Quinn applied for a lease over the abandoned site but a new group comprising members of the original syndicate and lead by Charles McKenny, manager of Texas Station was formed. A sample was sent to Brisbane metallurgists H.G. Stokes and E. Hall revealing 200 oz/t of silver.[92] Edgar Hall took a controlling interest in the mine, and it was successfully worked until 1921 with a hiatus between 1913 and 1918. The deposit was a pyritic lode containing silver associated with zinc, lead, minor copper and gold.[93] Ore was smelted on site in reverberatory furnaces, and the silver-rich copper matte shipped to England for final treatment. The small township of Silver Spur developed next to the mine and in 1908 had a population of 700 and the unusual distinction of being the largest town in Queensland not to have a licensed hotel.[94]

Small silver-bearing deposits were found to the north of Silver spur but were not economic. Modern exploration from 1971 led to the discovery of a large silver deposit at Twin Hills 2.4 km to the northwest, which was worked between 2008-2013 using heap-leach processing for 1.4 M oz of silver.[95]

Little Plant Creek (Webbs)

Silver was discovered at Little Plant Creek by tin miner Louis Webb when, in 1884, he showed some metallic samples he had collected to John Pentecost, a visiting geology lecturer from the Board of Technical Education.[96] Pentecost had the samples assayed to reveal high values of silver. This was at the height of the silver boom and the Webb's Silver-mining Company was quickly formed to prospect the site, however there were problems and delays in deciding the best method of treating the complex, polymetallic ore.[97]

Subsequently the White Rock Silver-mining Company from Drake acquired and extensively developed the mine, producing concentrates with a primitive processing plant.[98] A larger concentration plant with Cornish rolls and mechanical jiggers was set up in 1899 to improve ore processing and throughput. Concentrates were sold to the custom smelting works at Dapto and up to 1901 about 55 000 t of ore were mined.[99] The operation continued to 1906, employing up to 100 workers.

In 1927 the Webbs Silver Mine Prospecting Company was formed to dewater and re-open the mine. This continued for some time and a new plant was built in 1931, trialling selective oil flotation as a method to overcome the metallurgical problems.[100] Since 1946 a number of mining companies have explored and tested the site for potential silver mining.[101]

Borah Creek (Howell)

The Borah Creek polymetallic silver deposit, 25 km south of Inverell, (including the main Conrad and King Conrad mines) was discovered in 1890. It was not until 1897, when the prospector's claim was purchased by John Howell that systematic prospecting was carried out.[102] Similar to Webbs silver mine, the complex mineralogy of the ore and particularly the presence of stannite, presented metallurgical problems. Ore was processed using a similar system of grinding and concentration with mechanical jigging, with the concentrate sent to the Cockle Creek Smelting Works. In 1902 the mine had a workforce of 200 and the small settlement of Howell was established near the mine. The Conrad mine was worked intermittently until 1957 and more recently has been the focus of further exploration. Recorded production is approximately 200 000 t averaging 20 oz of silver/t, 8% lead, 4.5% zinc 1.5% copper and 1.5% tin.[103]

Base metals

Copper, lead and zinc have been produced from numerous small deposits scattered across New England, including some worked for their associated precious metals and tin. Some are associated with volcanic rocks, such as in the Halls Peak area, discovered in the early 1890s. The more important and interesting copper-dominant deposits include Cangai, Gulf Creek and Attunga.

Cangai

The Cangai copper deposit, near Jackadgery, was discovered by John Seller in August 1901 while he was wallaby hunting. The deposit was prospected and mined by a number of parties before the Grafton Copper Mining Company Ltd was floated in 1904. Amateur geologist Farther John Milne Curran became a shareholder and geological advisor. In 1905 the company built a copper smelter with two 40-ton reverberatory furnaces, later expanded to four. In 1906 the operation employed 70 miners and numerous teamsters supplying wood for the smelters. The mine operated until 1917, producing 5060 t of copper, 52.7 kg of gold and 1035 kg of silver. Discovery of the deposit was relatively late in the history of New England mining and the mine was unusual in that it paid for its own development due to the rich, self-fluxing ore and a low production cost partly related to a downhill gravity system for transporting ore to the smelter.[104]

Gulf Creek

The history of the Gulf Creek copper mine near Barraba, is almost a microcosm of the highs and lows of the Australian copper industry before WWI. Copper was discovered around 1876 and there was sporadic, minor production until 1893 when the Cornish Copper Company acquired the property.[105] This company began significant mining and on-site smelting with a single reverberatory furnace and by 1895 employed 40 men and was producing 12 t of copper matte per week.[106] The plant was upgraded to three furnaces, including a blast furnace, but although the operation was a technical success it was not sufficiently profitable and was closed in 1898. W.H. Trewenach took over the mine, worked it for a short time and then sold it to the Mine and Financial Syndicate of London, who floated the Gulf Creek Ltd Company in 1899.[107] The new company refurbished the plant and extended the mine to produce about 1200 t of ore per month with a workforce of 300. Over capitalisation and a sharp drop in the price of copper led to the closure of the mine in April 1902. An interesting occurrence during this period of mining was the spontaneous combustion of about 500 t of pyritic ore in one of the stopes, which saved the company the cost of calcining the ore.[108] After this closure, the mine was worked for a period by a group of the miners and then acquired by the London Metal Banking Company. Up to 1911, this company expended over £30 000 on further development, outlining a resource of 140 000 t, but were unable to re-open the mine.[109]

Other polymetallic deposits (tungsten, bismuth, molybdenum)

Kingsgate

During the tin rush of the early 1870s, an Adelaide company discovered unusual quartz-rich pipes containing bismuth, molybdenum and minor tungsten mineralisation near Kingsgate, 25 km east of Glen Innes. At least 70 pipes were eventually discovered, with production coming from 54. The pipes contained little tin, but some tungsten was initially produced. In September 1879 John Feeney, a stockman on Yarrow Creek station, picked up a metallic sample that was identified as native bismuth. On the advice of Mr H. Ferguson, Member of Parliament, it was decided to switch to mining the bismuth and a number of mines operated including the Kingsgate Bismuth Company and the Glen Innes Company. Between 1883 and 1889, David Marks and Ebenezer Vickery, who had consolidated a number of the leases produced about 220 t of 45% bismuth concentrate using a waterwheel-driven mill, sluice boxes, shovel and a birch broom.[110]

Until the development of molybdenum alloy steel in the late nineteenth century, there was little demand for molybdenite. During 1885-87 Marks and Vickery produced a few tonnes, but it was not until 1902 that attention and significant production turned to this component of the pipes. In 1901 Valentine Sachs, a German born tinsmith and soap maker in Glen Innes, secured the ‘Old No 45’ pipe, discovered in 1880 by the Glen Innes Company and worked by them until 1890. A rich patch of molybdenite and bismuth ore was found in a huge vugh, 15 m across, and many tonnes of molybdenite were extracted. William Yates, who had been heavily involved in the early mining activity, particularly as mine manager for Marks and Vickery, purchased their property in 1905. He progressively improved the operation and in 1912 installed two new mills for the separation of molybdenite and bismuth concentrates. Kingsgate Molybdenite NL acquired the Yates property in February 1918, commencing work in March with 45 men, but their operation was short lived.[111]

Pauline Speckhardt, stepdaughter of Valentine Sachs and also known locally as the ‘Lady Miner’, was involved in the Kingsgate mines from 1914 until her death in 1938. She inherited a large shareholding in Kingsgate Molybdenite NL, but also took out leases in her own name.[112] In 1948, E. Moskovits (acting for

Kingsgate Mining Industries Pty Ltd) produced some molybdenite and wolframite concentrates from reworking the old dumps. All mining had ceased by 1951. A small quantity (182 kg) of piezoelectric quartz for radio transmitters was produce from the pipes during WWII.[113] In 1966 and 1969 the field was investigated for possible open cut mining of low-grade ore, but without success.

Incomplete records indicate a total production of at least 200 t of bismuth, 350 t of molybdenite and 12 t of wolframite-bismuth concentrate from Kingsgate, making it the largest producer of molybdenite in NSW. Post-mining, the Kingsgate pipes with their spectacular crystals have become an important mineral collecting site.

Numerous other deposits containing tungsten, bismuth and molybdenum occur throughout New England. Important tungsten deposits are associated with the Torrington inlier, whilst bismuth and molybdenum are found near Attunga, Deepwater, Bolivia Range and Mount Jonblee. Some of these have been mined on a small scale.[114]
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Gemstones

The New England region is renowned for gemstones, particularly sapphires, zircons, topaz, beryl and diamonds, as well as semi-precious stones. Production has come from industrial mining and fossicking. Sapphires and rubies are related to the Tertiary basalts and associated tuffs and found in alluvium derived from these rocks, particularly in the Inverell-Glen Innes area. The sapphires are mostly small, rarely reaching 40 carats, and less than 20% are gem quality.[115] The first commercial mining was at Frazers Creek in 1919. Large scale production commenced in the 1960s and peaked in the 1970s, when up to 100 sapphire mining plants were in operation. The Braemar sapphire field and the Kings Plains area were major producers.[116]

Diamonds were first discovered by alluvial gold and tin miners, particularly during deep lead mining in the Copeton-Bingara area. Here the diamonds were mined in leads below basalt from 1875. The New England diamonds have some unusual characteristics and to date their primary source has not been definitively determined. The Copeton area has been the largest producer of diamonds in eastern Australia.[117]

Industrial minerals and materials

Prior to European settlement, Aboriginal people had for thousands of years utilised mineral resources including mineral pigments and clays, as well as quartz, silcrete and various rock types for tools. At Moore Creek, north of Tamworth, is one of the largest known quarries used for making high quality stone axes. The quarry is in a ridge of greywacke and axes from here were widely traded and have been traced as far as Bourke and Wilcannia in western NSW.[118] Other quarries were at Salisbury, near Uralla. Industrial minerals that have been mined since European settlement, include pipeclay; chromite; bauxite; and asbestos.

Asbestos

Chrysotile (white) asbestos has been mined at two main sites in the New England region. Mining developed during and after WWI in response to an asbestos shortage and demand from new uses in cheap building materials. At one time there were more than 3000 reported uses for asbestos, and it was described as a 'wonder mineral', before its deleterious health effects were realised.

At Baryulgil, northwest of Grafton, asbestos was first mined between 1914 and 1918. The mine was re-opened in the 1920s and further developed during WWII and mined continuously from 1941 by Asbestos Mines Pty Ltd. Up to 1970, 16 999 t of fibre were produced before the mine was closed in 1979.[119] Asbestos was reported by a drover near the old gold mining village of Woodsreef, east of Barraba, in 1884.[120] Between 1918 and 1923 the deposit was worked from two small quarries by the Asbestos Mining Company of Australia and Wunderlich Ltd. A number of companies explored and tested the deposit from 1950 and in 1971 Woodsreef Mines Ltd commenced large-scale mining. Approximately 500 000 t of asbestos fibre were produced from 100 Mt of mined serpentinite, before the mine closed in 1985.[121]

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