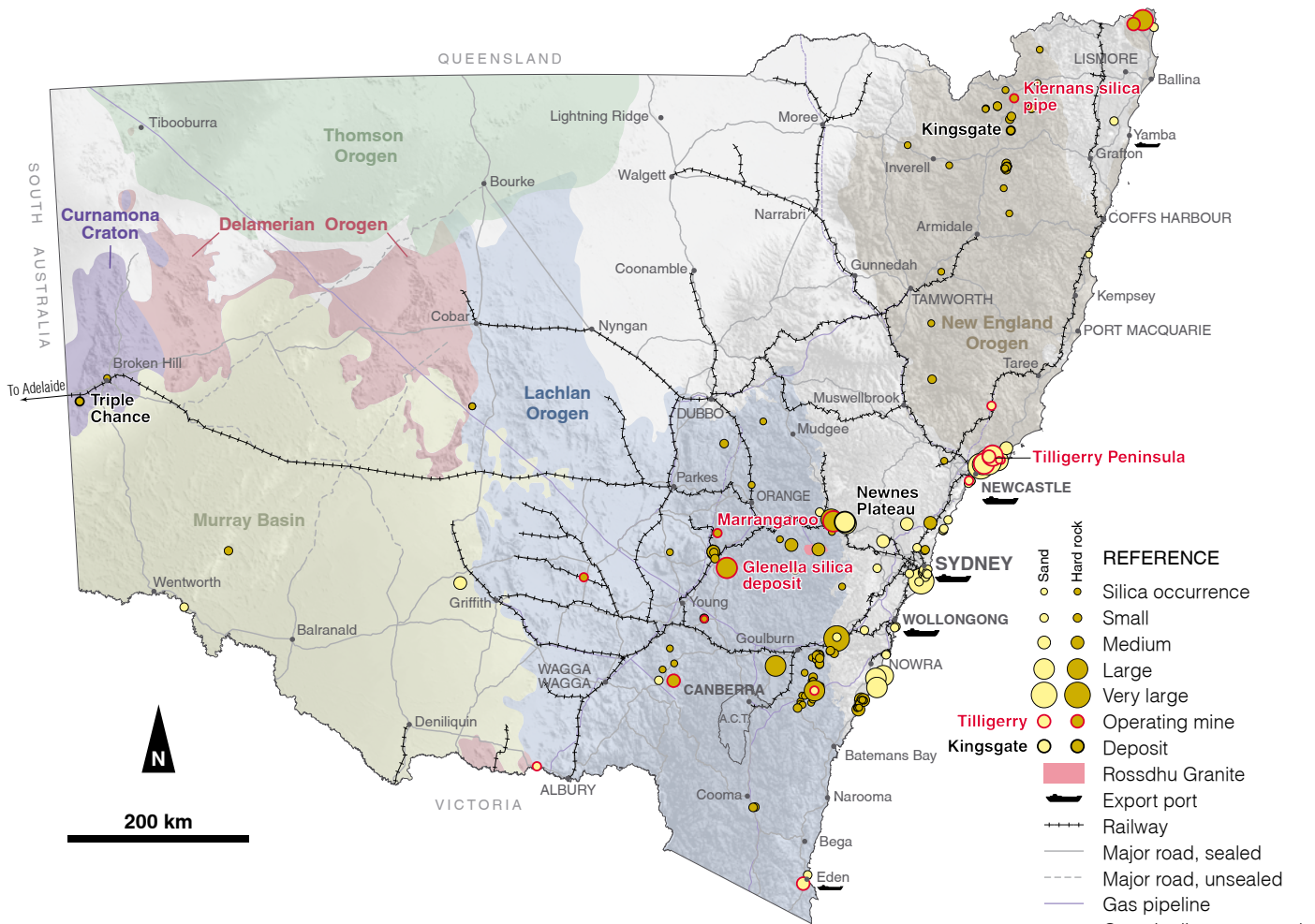


Silica

Opportunities in New South Wales, Australia

FEBRUARY 2015



Overview

- New South Wales (NSW) hosts pure silica sand deposits, high quality hard-rock silica deposits and extensive friable sandstones suitable for processed silica sand.
- Average production for 2008-12 was about 654 000 tpa.
- Global demand for industrial silica sand is projected to grow 4.8% annually to 280 Mt in 2016, with a value of \$9.2 billion.
- The glass market accounted for 36% of the total industrial sand usage worldwide in 2011.

Geological setting

Silica (silicon dioxide, SiO₂) mainly occurs naturally as crystalline quartz. Quartz is the main constituent of most sand (and gravel) deposits, and occurs widely in igneous (especially granite), metamorphic and sedimentary rocks.

Most industrial applications require >97% SiO₂. Glass-making sand in Australia must be pure, containing >99.5% SiO₂, with very low Fe, Cr, Ti and other discolouring contaminants.

Key geological associations in NSW:

- Coastal dunes are a major direct (unprocessed) source of fine-grained silica sand.
- Leached Pleistocene barriers within a few km of the east coast host large fine- to medium-grained deposits.
- Coastal Holocene dunes are also major sources of unprocessed and processed silica sand.
- Friable sandstone of Triassic age occurs in the Greater Sydney area.
- Quartzite, quartz gravel and reef quartz deposits are current and potential sources of coarse silica and of high purity quartz. They include coarse-grained unconsolidated quartz cobble and pebble conglomerate (such as Cenozoic alluvial deposits).
- Pegmatite and granitic rock can be processed for quartz along with feldspar. Granite can also host massive quartz pipes.

Project highlights

Port Stephens

For over 40 years, the Port Stephens–Stockton Bight area (near Newcastle) has been a major source of construction and industrial sand, producing several hundred thousand tonnes annually.

Coastal sand deposits of Holocene age are major sources of construction sand, including that processed for industrial uses such as coloured glass manufacture.

Tilligerry Peninsula has extensive Pleistocene inner barrier sand deposits, and is the main source of silica sand in NSW, supplying most colourless glass manufacturing plants in the state.

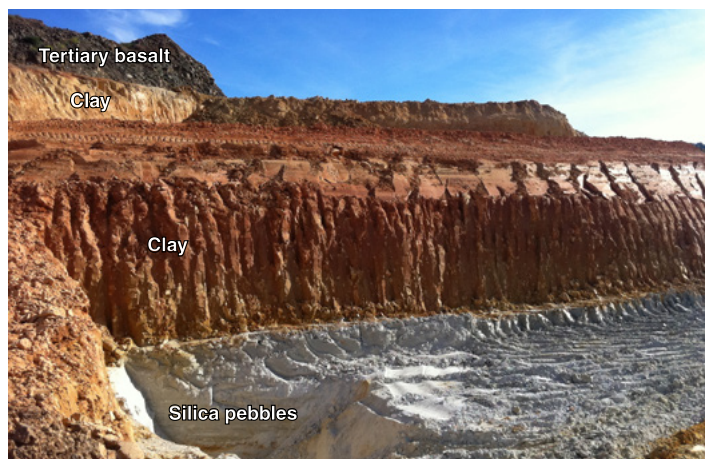
Marrangaroo quartzite quarry (near Lithgow)

Marrangaroo quarry was once a principal source of silica for foundry sand and flux for steel making. Current production comprises various crushed quartzite aggregates for road making and concrete manufacture.

Glenella silica deposit (near Cowra)

The deposit occurs as quartz pebble conglomerates beneath Tertiary basalt and alluvial deposits >99.88% SiO₂. Potential end uses include silicon metal for electronics, refractories and crucibles.

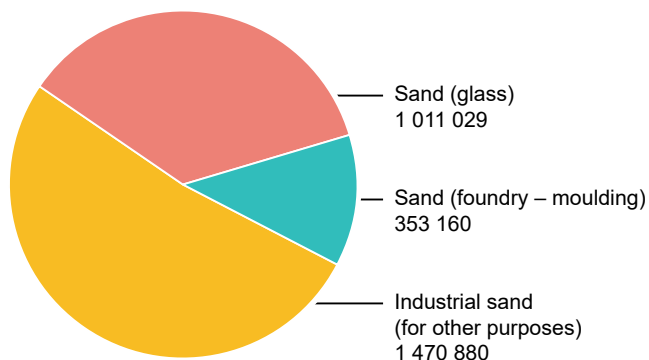
Quartz pebble horizon: (measured & indicated)
6.9 Mt @ 40.4% SiO₂ pebbles (+8 mm).



Stratigraphic section including quartz pebble deposits (courtesy of Glenella quarry).

Silica production for NSW in 2009–13 (in tonnes)

Total production >2.8 Mt



Contact: mra.info@geoscience.nsw.gov.au | +61 2 4063 6500

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Development opportunities

Industrial silica sand

- Holocene coastal dune sands are fine- to coarse-grained, moderately to well-rounded and suited to numerous construction and industrial applications (e.g. Port Stephens, Kurnell).
- Inner barrier Pleistocene dune deposits include the Tilligerry Peninsula in the Port Stephens area.
- Potentially large resources of fine-grained, high-purity leached silica sand in deposits several metres thick occur in Pleistocene barrier dunes west of Forster–Tuncurry.
- Friable sandstone of Triassic age occurs extensively in the Sydney Basin (e.g. Newnes Plateau and Maroota).
- Quartz cobble and gravel deposits of Tertiary (Neogene–Paleogene) age may include large accumulations (e.g. Cowra area, including Glenella).

Hard rock opportunities

- Marrangaroo quarry has considerable potential to supply silica for a range of applications.
- Large, low iron granites such as the Rossdhu Granite near Oberon have undeveloped potential for quartz and feldspar for glassmaking.
- The Kingsgate district has massive quartz pipes in granite that are suitable for use in semi-conductors and for piezoelectric quartz.
- Pegmatites are widespread in the Broken Hill region (Curnamona Craton) and represent potential for small-scale silica production, along with feldspar and beryl (e.g. Triple Chance and nearby Lady Beryl).

End uses

Glass and foundries are the most dominant end uses by volume. Glass sands used in Australia require a silica purity of 99.5% and varying levels of Fe₂O₃ and other impurities.

Other uses of silica worldwide include:

- Metallurgical (flux)
- Silicon metals, ferrosilicon
- Silicon
- Silicon carbide
- Electronics, including semiconductors
- Piezoelectrics as quartz crystals
- Chemicals (cosmetics and pharmaceuticals)
- Sealants and adhesives
- Fillers, rubber, paints, putty
- Whole-grain fillers/building products
- Ceramics, pottery, brick, tile
- Hydraulic fracturing
- Filtration
- Sports grounds
- Beach replenishment
- Roofing granules and fillers
- Agriculture (soil conditioning, fertilisers, animal feeds)
- Abrasives (blasting)

Source: <http://minerals.er.usgs.gov/minerals/pubs/commodity/silica/myb1-2012-silic.pdf>