AUSTRALIAN ANTARCTIC TERRITORY

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Australian Antarctic Division

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Geoscience Australia

GEOLOGY OF NORTHERN JETTY PENINSULA

MAC.ROBERTSON LAND
ANTARCTICA

Edition 1

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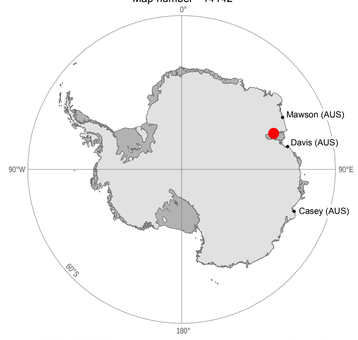

PROJECTION: Universal Transverse Mercator Zone 42
HORIZONTAL DATUM: WGS84
VERTICAL DATUM: Mean Sea Level
NOMENCLATURE: All named geographic features on this map are registered with the Scientific Committee for Antarctic Research (SCAR) Composite Gazetteer of Antarctica.

SCALE 1:25 000

0 0.5 1 2 3 4 Kilometres

TN GN
0.2°
MN
74°

True North, Grid North and Magnetic North are shown diagramatically for the centre of the map.

Magnetic North is correct for November 2012. It moves westerly by approximately 0.15° per year.

Scientific station
Fossil wood locality
Geological boundary
Seasonal limit of snow field
Fault, position accurate
Fault, position inferred
Snow field
Water body

QUATERNARY

Qsg — undifferentiated glacially derived sediments
Poorly or unconsolidated moraine, till, diamictite and other peri-glacial deposits.

Mqv — quartz pods and veins
Undeformed resistant outcrops of massive white quartz veins. Rare coarse K-feldspar and carbonate. May contain mafic xenoliths. Associated with local epidote alteration of mafic dykes. Related to rifting during formation of Lambert Graben during the break up of Gondwana.

MESOZOIC

ca. 110-150 Ma (Andronikov (1990); Hoffmann (1991)) — **Makd** — alkaline stocks and pipes
Alkaline picrites occuring as 'stocks, sills and dykes' (Andronikov, 1990). May contain mantle derived xenoliths (dunite, wehrlite, garnet+spinel lherzolite and harzburgite). Mainly exposed on Kamenistaja Platform.

Mtm — Toploje Member (basal member of Bainmedart Coal Measures; Amery Group)
Coarse grained alluvial and fluvial well-sorted sandstones (ca. 300 m thick; McLoughlin and Drinnan 1997) May contain petrified wood fragments. Faulted bounded with Proterozoic basement, near Soyuz station.

ca. 308-320 Ma (Hoffmann (1991); Mikhalsky and Sheraton (1993)) — mafic dykes
Undeformed compositionally varied suite of mafic dykes including alkaline dolerite-camptonites, trachydolerites and diorites. Generally north-south trending, 5-10 m wide, may extend laterally for 100's of metres. Vesicular, fine grained with chilled margins. Aligned laths of plagioclase and K-feldspar enclosing olivine (now chlorite) and titanaugite, locally sbiottteszmagnetite. Secondary prehnite and epidote.

PALEOZOIC

ca. 500 Ma (Manton et al (1992)) — **Csp** — Stagnant Pegmatite
Coarse grained massive quartz+feldspar+garnet+biotite pegmatites, rare orthopyroxene and/or magnetite bearing varieties occur. Range in occurance from small randomly oriented veins up to several metres across to large roughly north trending bodies up to 2 km in length and 750 m in width.

ca. 500 Ma (Manton et al (1992)) — **Cgd** — granite dykes
Sinuous, broadly north trending migmatized granitic dykes, comprised of foliated garnet-biotite stromatic leucosomes. Dykes up to ca. 15 m wide, steeply dipping and in sharp contact with country rock; gneissosity in country rock adjacent to dyke is transposed parallel to the N-S fabric within the dykes. Minor horizontal offset associated with dyke emplacement, generally <30 m.

NEOPROTEROZOIC

ca. 939 Ma (Scrimgeour (1992)) — **Pmg** — Melkoe Granite
Homogeneous medium grained equigranular pale garnet granite (plagioclase+K-feldspar+quartz), weakly to locally strongly foliated, with an array of dykes radiating from the main body on Else Platform (see photo).

ca. 940 Ma (Manton et al (1992)) — **Psl** — Soyuz Leucogranite
Leucocratic quartzo-feldspathic gneiss with abundant small garnet and rare biotite. Contains deformed xenoliths. Gradational or diffuse boundary with surrounding units. Strongly foliated leucocratic dykes with elongate aggregates of garnet+quartz in a granoblastic matrix of K-feldspar, plagioclase and quartz.

Pcg — Chistoe Granite
Biotite granite characterised by megacrysts of perthitic K-feldspar (up to 10 cm in length), and inclusion-rich garnet. May locally contain xenoliths of Kamenistaja Paragneiss. Major rock unit in southern and north-eastern Else Platform and northern Kamenistaja Platform.

ca. 1000 Ma (Manton et al (1992)) — **Peg** — Else Gneiss
Quartzo-feldspathic orthopyroxene biotite gneiss, typically with 'greasy-green' lustre. Layering defined by metre-scale variation of orthopyroxene, biotite, plagioclase and K-feldspar. Unit may locally contain discontinous lenses of calc-silicate (C) and mafic gneiss (M). Pegk; undifferentiated biotite-orthopyroxene gneiss with abundant calc-silicate and pyroxenite lenses and subordinate biotite-garnet gneiss (southern Kamenistaja Platform).

MESO-PROTEROZOIC

Pkp — Kamenistaja Paragneiss
Heterogeneous garnet-bearing gneiss comprising interleaved quartzo-feldspathic gneiss, semi-pelitic metapsammite and sillimanite-bearing metapelites. Calc-silicate (C) and mafic gneiss (M) lenses and rare ultramafic (UM) boudins may be present. May also contain intercalated orthopyroxene-biotite gneiss.
Ppg; Coarse grained garnet+sillimanite+biotite (± spinel±cordierite) migmatised pelitic paragneiss with layering defined by alternating stromatic leucosomes and melanosomes. Generally occur as narrow elongate bands up to 10 m in width and up to 100 m in length within the Kamenistaja Gneiss .
Pqfg; Compositionally homogeneous quartzo-feldspathic felsic gneiss, variably migmatised, comprised of garnet+biotite+K-feldspar+quartz. Contains strong fabric defined by elongated garnet+biotite, locally mylonitic. Contact with Kamenistaja Paragneiss locally gradational.

Data compilation and acknowledgements

Geology:
1989/90 M. Hand, I.R. Scrimgeour, K. Stüwe, D. Arne (Else Platform)
1990/91 I.R. Scrimgeour (Kamenistaja Platform)

Compiled 2010-2012 by B. Reese, A. Spalding, Geoscience Australia
GIS consultation P.J. Butler, M.A Woods, D. Arnold, Geoscience Australia; H. Brolsma, Australian Antarctic Data Centre
Cartography by M.A. Woods, Geoscience Australia

It is recommended that this map be referred to as: M. Hand, I.R. Scrimgeour, K. Stüwe, D. Arne and C. J. Carson, 2012. Geology of northern Jetty Peninsula, Mac.Robertson Land, Antarctica. 1st edition (1:25000) Geoscience Australia.

Stratigraphic column indicative only, largely based on available published and unpublished geochronology. Indicated conformable contacts and unconformities are speculative and inferred only. Primary lithological contacts and relationships obscured by overprinting ca. 900-1100 Ma Rayner high-grade tectonothermal events.

Place names: - http://data.aad.gov.au/aadc/gaz/scar/
Geochemistry and geochronology: - http://www.ga.gov.au/

The Commonwealth takes no responsibility for the spatial accuracy of geological features and boundaries on this map. Map not to be used for navigation purposes.

For further reference to the geology of northern Jetty Peninsula (incorporating Else and Kamenistaja Platforms) the following selected publications are recommended:

Andronikov AV. 1990. *Spinel-garnet lherzolite nodules from alkaline ultrabasic rocks of Jetty Peninsula (east Antarctica).* Antarctic Science, 2, 321-330.

Andronikov AV., and Egorov LS. 1993. *Mesozoic alkaline-ultrabasic magmatism of Jetty Peninsula*. IN: Findlay RH., Unrug R., Banks M.R., and Veevers JJ. (eds). Gondwana Eight: Assembly, evolution and dispersal. Balkema, Rotterdam, 547-557.

Grew ES. 1985. *Field studies on the Jetty Peninsula Amery Ice Shelf area with the 30th Soviet Antarctic Expedition*. Antarctic Journal of the United States, 20(5), 52-53.

Hand M., Scrimgeour I., Powell R., Stüwe K., and Wilson CJL. 1994a. *Metapelitic granulites from Jetty Peninsula, east Antarctica: Formation during a single event or by polymetamorphism?* Journal of Metamorphic Geology, 12, 557-573.

Hand M., Scrimgeour I., Stüwe K., Arne D., and Wilson CJL. 1994b. *Geological observations in high-grade mid-Proterozoic rocks from Else Platform, northern Prince Charles Mountains region, east Antarctica*. Australian Journal of Earth Sciences, 41, 311-329.

Hoffman J. 1991. *Fault Tectonics and magmatic ages in the Jetty Oasis area, Mac.Robertson Land: A contribution to the Lambert Rift development*. IN: Thomson MRA., Crame JA., and Thompson JW. (eds). The Geological Evolution of Antarctica. Cambridge University Press; 107-112.

Kamenev EN., Andronikov AV., Mikhalsky EV., Krasnikov NN., and Stüwe K. 1993. *Soviet geological maps of the Prince Charles Mountains, east Antarctic Shield.* Australian Journal of Earth Sciences, 40, 501-517.

Manton WI., Grew ES., Hofmann J., and Sheraton JW. 1992. *Granitic rocks of the Jetty Peninsula, Amery Ice Shelf Area, East Antarctica*. IN: Recent Progress in Antarctic Earth Science by Yoshida Y., Kaminuma K., and Shiraishi K. (eds). Terra Scientific Publishing Company, Toyko, pp. 179-189.

McKelvey BC., and Stephenson NCN. 1990. *A geological reconnaissance of the Radok Lake area, Amery Oasis, Prince Charles Mountains*. Antarctic Science, 2 (1), 53-66.

McLoughlin S., and Drinnan AN. 1997. *Revised stratigraphy of the Permian Bainmedart Coal Measures, northern Prince Charles Mountain, east Antarctica*. Geological Magazine, 134(3), 335-353.

Mikhalsky EV., and Sheraton JW. 1993. *Association of dolerite and lamprophyre dykes, Jetty Peninsula (Prince Charles Mountains, East Antarctica)*. Antarctic Science, 5(3), 297-307.

Mikhalsky EV., Sheraton JW., Laiba AA., Tingey RJ., Thost DE., Kamenev EN., and Fedorov LV. 2001. *Geology of the Prince Charles Mountains, Antarctica*. AGSO-Geoscience Australia, Canberra; Bulletin 247.

Mond A. 1972. *Permian sediments of the Beaver Lake area, Prince Charles Mountains*. IN: Adie RJ. (ed.). Antarctic Geology and Geophysics. Universitetsforlaget, Oslo, 585-589.

Scrimgeour IR. 1994. *Evolution of granulites from Mac.Robertson Land, East Antarctica*. Unpublished PhD thesis, University of Adelaide.

Webb JA., and Fielding CR. 1993. *Permo-Triassic sedimentation within the Lambert Graben, northern Prince Charles Mountains, east Antarctica*. IN: Findlay RH., Unrug R., Banks M.R., and Veevers JJ. (eds). Gondwana Eight: Assembly, evolution and dispersal. Balkema, Rotterdam, 357-369.

HOW TO QUOTE A GRID REFERENCE FOR A PARTICULAR POINT

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2. Locate the VERTICAL grid line to the left of the point 492
3. Estimate metres from the grid line to the point 000
4. Locate the horizontal GRID LINE BELOW THE POINT 2169
5. Estimate metres from the grid line to the point 800

Thus, the reference for SOYUZ BASE is: ...GEOLOGY OF NORTHERN JETTY PENINSULA 14142
492000, 2169800

The grid interval on this map is 1000 metres

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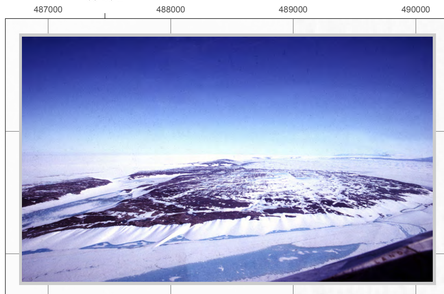
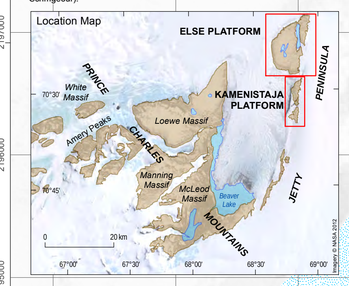
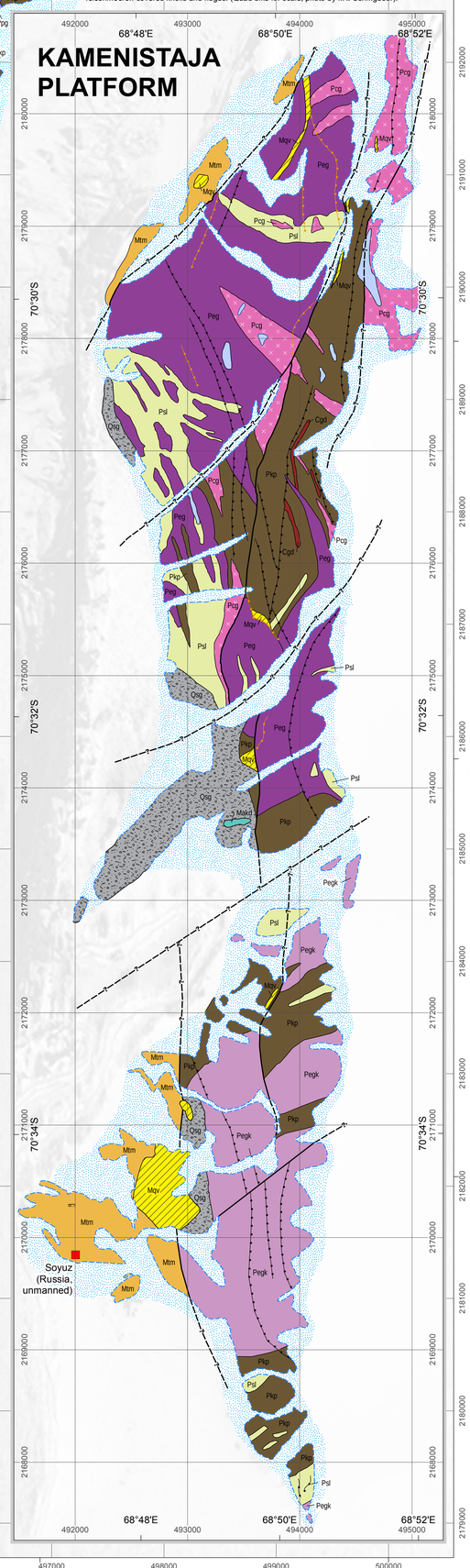


Oblique aerial view looking south onto Else Platform (foreground) and Kamenistaja Platform in distance (centre), Chistoe Lake on left, Amery Ice Shelf on far left. Beaver Lake visible at far centre right. Note the 'table-top' nature of Else Platform (~150 m a.s.l.), due to erosional peneplanation during past ice sheet advances. (photo taken from altitude of ~500 m; width of Else Platform for scale ~ 8 km, photo by I.R. Scrimgeour).

Oblique aerial view of central Else Platform, facing east. This view shows the radiating offshoots of the Melkoe Granite intruding into the surrounding gneisses. Note also the narrow east-west trending alkaline mafic dyke. (Scale ~2 km from left to right, photo taken at altitude of ~1000m; photo by I.R. Scrimgeour, also see Figure 3a in Hand *et al.* 1994b).



View across Else Platform facing southwest, to Beaver Lake and the distant northern Prince Charles Mountains. Note the typical heavily frost-shattered nature of the outcrop resulting in *felsenmeeren* covered knolls and ridges. (Quad bike for scale; photo by I.R. Scrimgeour).



Northern Jetty Peninsula – Geological Summary

Northern Jetty Peninsula, incorporating Else Platform (~140 km^2) and Kamenistaja Platform (~15 km^2), represents a mostly ice-free low-lying region located on the western flanks of the Lambert Graben. The region is predominantly comprised of granulite-facies Proterozoic gneisses and unmetamorphosed Permian sediments.

Metamorphic rock types include quartzo-feldspathic, pelitic and semi-pelitic metasedimentary rocks of probable Mesoproterozoic age (Kamenistaja Paragneiss and Else Gneiss). Minor intercalated ultramafic and calc-silicate bodies are also present. Neoproterozoic (ca. 940-1000 Ma) syn-tectonic felsic intrusives (megacrystic Chistoe Granite, Melkoe Granite and Soyuz Leucogranite) are also widespread.

Proterozoic rocks are subsequently intruded by Paleozoic granite dykes and the felsic Stagnant Pegmatite, alkaline mafic dykes (ca. 308-320 Ma) and Mesozoic alkaline stocks and pipes. The Toploje Member of the Amery Group (a sequence of Permo-Triassic fluvial siliciclastic rocks, which outcrop extensively on the southern and western flanks of Beaver Lake) is exposed on southwestern Kamenistaja Platform and appears fault-bounded against the high-grade Proterozoic rocks.

Together with adjacent high-grade rocks in Kemp and Mac.Robertson Lands to the west, the rocks of northern Jetty Peninsula form part of an extensive Meso-Neoproterozoic high-grade mobile belt (the 'Rayner Orogeny'; ca. 900-1100 Ma). During this event, on Else Platform, peak metamorphic conditions reached pressures as much as ~6.5 to 7.5 kbar at temperatures ~ 800° C and resulted in the development of a pervasive gneissosity (the dominant form surface, S_1). Localized high-strain zones (S_2) developed during latter stages of the high-grade metamorphic evolution, conditions during which are estimated at ~5 to 6 kbar at temperatures ~700° C.

The intrusion of north-trending granite dykes (and their subsequent deformation) at ca. 500 Ma occurred at probable upper amphibolite-facies, indicating that an early Paleozoic event (which reached granulite-facies in Prydz Bay, ~200-300 km to the northeast) significantly affected the Jetty Peninsula region.

Minor northwest-trending steeping dipping mylonites and vertical north-trending brittle faults cut all rock types, except the massive quartz 'blows' and veins. These quartz pods are locally abundant (e.g. near Soyuz station), and, together with the late brittle faults, are thought to be related to incipient rifting of the Lambert Graben during the breakup of Gondwana.

Isotope Geochronology of northern Jetty Peninsula

The available geochronology of northern Jetty Peninsula and surrounding regions is sparse. No estimates for the depositional age of the meta-sedimentary units (Kamenistaja Paragneiss and the Else Gneiss) currently exist. These units were probably deposited during the Mesoproterozoic.

A Thermal Ionisation Mass Spectrometry (TIMS) U-Pb zircon age of 1000 +14/-11 Ma on the Else Gneiss (Manton et al. 1992; sample 625) is interpreted as a metamorphic age, reflecting the regional granulite-facies tectono-metamorphism of the Rayner Orogeny (ca. 900-1100 Ma). Manton et al. (1992; sample 675) reported a TIMS U-Pb zircon upper intercept age of 940 +24/-17 Ma on the Soyuz Leucogranite, which is interpreted as an emplacement age. This age is similar to the unpublished two-point Sm-Nd isochron of ca. 939 Ma (Scrimgeour 1994, p. 43) on the Melkoe Granite. This age is tentatively interpreted to represent a metamorphic age, reflecting the latter stages of the Rayner Orogeny.

Efforts to determine the emplacement age using SHRIMP zircon U-Pb analysis on the Chistoe Granite (GA sample numbers 2131319, 2131320) proved inconclusive, as did attempts to confirm the emplacement age of the Soyuz Leucogranite (GA sample numbers 2131317, 2131318). No reliable SHRIMP zircon ages could be determined from these units.

Stagnant Pegmatite was emplaced at ca. 495-505 Ma (U/Pb ages; Manton et al. 1992, sample 609). The north-trending mafic dykes on Jetty Peninsula were emplaced at ca. 308-320 Ma based on K-Ar whole rock analysis (Hoffman 1991; Mikhalsky and Sheraton 1993). The youngest intrusive rocks, such as stocks and breccia pipes of alkaline-ultrabasic composition exposed mainly on Kamenistaja Platform, were emplaced between ca. 110-150 Ma (K-Ar; e.g. Andronikov 1990; Hoffman 1991).