Aughenbaugh, N. B. 1961. Preliminary report on the geology of Dufek Massif. *International Geophysical Year World Data Center A, Glaciology Report*, 4, 155–193.

Behrendt, J. C., D. J. Drewry, E. Jankowski, and M. S. Grim. 1980. Aero-magnetic and radio echo ice-sounding measurements show much greater area of the Dufek intrusion, Antarctica, *Science*, 209(4460), 1014–1017.

Behrendt, J. C., J. R. Henderson, L. Meister, and W. L. Rambo. 1974. *Geophysical investigations of the Pensacola Mountains and adjacent glacierized areas of Antarctica.* (U.S. Geological Survey Professional Paper 844.) Washington, D.C.: U.S. Government Printing Office.

Ford, A. B. 1976. *Stratigraphy of the layered gabbroic Dufek intrusion, Antarctica.* (U.S. Geological Survey Bulletin 1405D.) Washington, D.C.: U.S. Government Printing Office.

Ford, A. B., R. E. Mays, J. Haffty, and B. P. Fabbi. In press. *Reconnaissance of minor metal abundances and possible resources of the Dufek intrusion, Pensacola Mountains.* Proceedings of the Fourth International Symposium on Antarctic Earth Sciences, Adelaide, Australia, 1982.

Ford, A. B., D. L. Schmidt, and W. W. Boyd, Jr. 1978. *Geologic map of the Davis Valley quadrangle and part of the Cordiner Peaks quadrangle, Pensacola Mountains, Antarctica (scale 1:250,000).* (U.S. Geological Survey Map A-101.) Washington, D.C.: U.S. Government Printing Office.

Ford, A. B., D. L. Schmidt, W. W. Boyd, Jr., and W. H. Nelson. 1978. *Geologic map of the Saratoga Table quadrangle, Pensacola Mountains, Antarctica (scale 1:250,000).* (U.S. Geological Survey Map A-9.) Washington, D.C.: U.S. Government Printing Office.

Himmelberg, G. R., and A. B. Ford. 1983. Composite inclusion of olivine gabbro and calc-silicate rock in the Dufek Intrusion, a possible fragment of concealed contact zone. *Antarctic Journal of the U.S.*, 18(5).

Himmelberg, G. R., and A. B. Ford. 1977. Iron-titanium oxides of the Dufek intrusion, Antarctica. *American Mineralogist*, 62, 623–633.

Himmelberg, G. R., and A. B. Ford. 1976. Pyroxenes of the Dufek intrusion, Antarctica. *Journal of Petrology*, 17, 219–243.

Lovering, J. F., and J. R. V. Prescott. 1979. *Last of lands . . . Antarctica.* Melbourne: Melbourne University Press.

Page, N. J, G. von Gruenewaldt, J. Haffty, and P. J. Aruscavage. 1982. Comparison of platinum, palladium, and rhodium distributions in some layered intrusions with special reference to the late differentiates (upper zone) of the Bushveld Complex, South Africa. *Economic Geology*, 77, 1405–1418.

Runnells, D. D. 1970. Continental drift and economic minerals in Antarctica. *Earth and Planetary Science Letters*, 8, 400–402.

von Gruenewaldt, G. 1977. The mineral resources of the Bushveld Complex. *Minerals, Science and Engineering*, 9(2), 83–95.

Wager, L. R., and G. M. Brown. 1967. *Layered igneous rocks.* San Francisco: W. H. Freeman.

Wilson, H. D. B. (Ed.). 1969. Magmatic ore deposits, a symposium. *Economic Geology Monograph*, 4. Symposium sponsored by the Society of Economic Geologists at Stanford University, Stanford, Calif. 1966.

Zumberge, J. H. 1979. Mineral resources and geopolitics in Antarctica. *American Scientist*, 67, 68–77.

# Geochronologic studies in East Antarctica: Reconnaissance uranium/thorium/lead data from rocks in the Schirmacher Hills and Mount Stinear

EDWARD S. GREW

*Institut für Mineralogie*
*Ruhr-Universität Bochum*
*Bochum, Federal Republic of Germany*

WILLIAM I. MANTON

*Program and Institute for Geosciences*
*The University of Texas-Dallas*
*Richardson, Texas 75080*

The Schirmacher Hills (70°45′S 11°50′E) are a coastal exposure of the Precambrian crystalline basement of Queen Maud Land (Ravich and Kamenev 1975; Ravich and Soloviev 1966). Mount Stinear (73°7′30″S 66°15′E) in the southern Prince Charles Mountains is composed primarily of a granitic and gneissic basement complex and of an amphibolite-facies metasedimentary cover of Precambrian age (Tingey 1982; Grew 1982). We report here uranium/thorium/lead (U/Th/Pb) data on 3 samples collected in the Schirmacher Hills and at Mount Stinear in 1973 and 1974 when Grew participated in the 18th and 19th Soviet Antarctic Expeditions (SAE) as U.S. exchange scientist. To the authors' knowledge, the only other radiometric data reported from these areas [aside from brief mention in Grew (1982; in press) of the U/Th/Pb data to be presented here] are potassium/argon (K/Ar) dates from central Queen Maud Land (0–20°E) (Ravich and Soloviev 1966), and a rubidium/strontium (Rb/Sr) date of 2,580 million years from Mount Stinear (Tingey 1982).

The Schirmacher Hills in the vicinity of the Soviet Station Novolazarevskaya are underlain by metamorphic rocks consisting largely of sillimanite-garnet gneiss, garnet-biotite gneiss, mafic granulite, minor calc-silicate granulite and marble, and rare sapphirine-garnet-biotite granulite (Grew in press). These rocks were metamorphosed in the granulite facies and subsequently in the amphibolite facies. Pegmatites containing allanite and tourmaline were emplaced during the amphibolite-facies event, and mafic dikes were emplaced both before and after the amphibolite-facies event.

Samples analyzed for U/Pb/Th isotopes from the Schirmacher Hills are 378X, a metamict allanite from pegmatite, and 395B, zircons from a quartzo-feldspathic gneiss containing unaltered garnet, biotite, and hornblende; and accessory apatite, opaque, calcite, and optically active allanite. Biotite forms clots of flakes in random orientation. This texture and the absence of pyroxene suggests that the gneiss had completely recrystallized during the amphibolite-facies event. In thin section, zircon crystals are commonly euhedral and some have cores. The analyzed zircons are clear and subhedral to euhedral. Cores were not apparent. Two size fractions were analyzed: 100–200 mesh and less than 200 mesh.

**Table 1. Uranium, thorium, and lead concentrations and isotopic ratios of minerals from the Schirmacher Hills and Mount Stinear, East Antarctica**

| Sample number | U | Th | Pb | $^{206}Pb/^{204}Pb$ | $^{206}Pb/^{207}Pb$ | $^{206}Pb/^{208}Pb$ | $^{207}Pb^{a}/^{235}U$ | $^{206}Pb^{a}/^{238}U$ | $^{208}Pb^{a}/Th$ |
|---|---|---|---|---|---|---|---|---|---|
| | (in parts per million) | | | | | | | | |
| Schirmacher Hills | | | | | | | | | |
| 378X | 1,122 | 19,300 | 6880 | 493.3 | 11.33 | 5.452 | 0.8461 | 0.1043 | 0.0327 |
| 395B | | | | | | | | | |
| (100–200 mesh) | 580.9 | n.d.[b] | 73.8 | 10,700 | 14.44 | 0.0742 | 1.296 | 0.1290 | — |
| ( < 200 mesh) | 478.8 | n.d.[b] | 63.0 | 2,360 | 13.54 | 0.0993 | 1.220 | 0.1295 | — |
| Mount Stinear | | | | | | | | | |
| 544 | 10,600 | 14,300 | 1,090 | 1,980 | 13.55 | 1.673 | 0.6509 | 0.0710 | 0.0296 |

[a] Radiogenic component

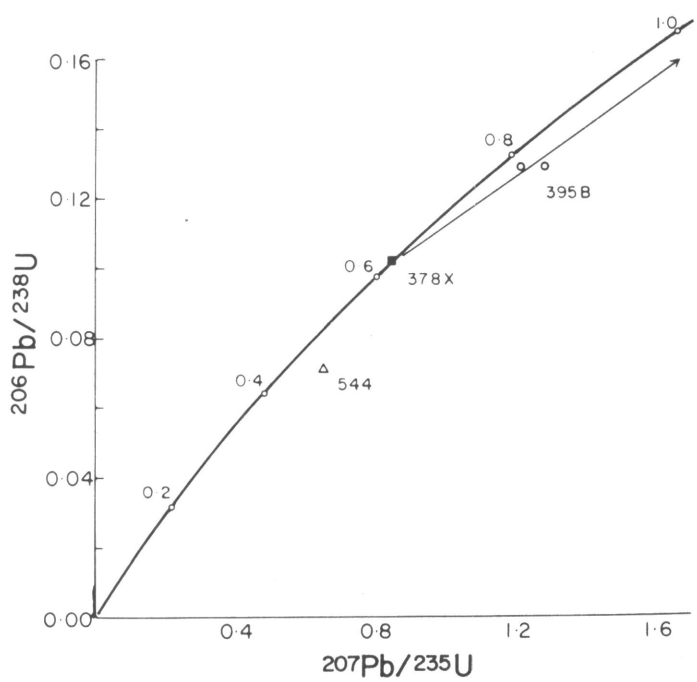
[b] None determined

The U/Th/Pb data on 378X are concordant (tables 1 and 2, figure) and indicate an age near 630 million years for crystallization of the allanite and pegmatite. This allanite age probably dates the amphibolite-facies metamorphism. The U/Pb data on 395B are discordant (figure), and the two size fractions do not lie on a meaningful line. A rather large common lead correction was associated with the smaller size fraction, which could in part explain the discrepancy between the two size fractions. With due allowance for possible errors, the data on 395B could be interpreted to indicate crystallization of the zircon roughly 1,500 million years ago and subsequent lead loss during the amphibolite-facies metamorphism 630 million years ago. An approximate age of 1,500 million years is thus suggested for the original crystallization of the gneiss, presumably in the granulite facies. The 630-million-year event also opened the K/Ar isotopic system. The maximum K/Ar ages reported by Ravich and Soloviev (1966) are 830 and 845 million years on mafic granulite from the Schirmacher Hills. Our geochronologic data suggest that the metamorphosed mafic dikes are Late Precambrian in age (probably less than 1500 million years), while the unmetamorphosed mafic dikes are Late Precambrian or Phanerozoic (less than 630 million years).

Sample 544 is a nodule several centimeters across collected from a pegmatite in the basement complex at Mount Stinear (Grew 1982). This nodule consists of several metamict yttrium-bearing minerals. The U/Pb data, obtained on the nodule as a whole, lie on a chord intersecting concordia at 0 and 850 million years (figure). One interpretation is that the nodule crystallized 850 million years ago and subsequently lost lead. However, Tingey (1982) reports an Rb/Sr age of 2580 million years on muscovite from a pegmatite cutting the metasedimentary rocks overlying the basement complex at Mount Stinear. The pegmatite from which 544 was collected appears to be part of the basement complex, and thus would be older than the overlying metasediments. An alternative interpretation of the data on 544 is that the nodule originally crystallized at some time before 2,580 million years ago and lost lead during more than one later event. Radiometric data from other exposures in the southern Prince Charles Mountains provide evidence for metamorphic and plutonic events about 1,000 and 500 million years ago (Halpern and Grikurov 1975; Tingey 1982). Lead loss during either of these events or both, as well as subsequently, could explain the marked discordance in the U/Pb data for 544.

**Table 2. Uranium-thorium-lead ages of minerals from the Schirmacher Hills and Mount Stinear, East Antarctica (in millions of years)**

| Sample number | $^{207}Pb/^{235}U$ | $^{206}Pb/^{238}U$ | $^{208}Pb/Th$ |
|---|---|---|---|
| 378X (Schirmacher Hills) | 623 | 640 | 651 |
| 544 (Mt. Stinear) | 509 | 442 | 589 |




**Concordia diagram for minerals from the Schirmacher Hills and Mount Stinear.**

This research was supported by National Science Foundation grants DPP 72-05797 to the University of Wisconsin-Madison, and DPP 80-19527 to the University of California-Los Angeles. Grew thanks members of the 18th and 19th SAE for their logistic support and cooperation. This report was prepared while Grew was a Humboldt-Stipendiat in Bochum.

### References

Grew, E. S. 1982. Geology of the southern Prince Charles Mountains, East Antarctica. In C. Craddock (Ed.), *Antarctic geoscience*, Madison: University of Wisconsin Press.

Grew, E. S. In press. The sapphirine-garnet association in Antarctica. In R. L. Oliver, J. B. Jago, P. R. James (Eds.), *Antarctic Earth Science*. Proceedings of the Fourth International Symposium on Antarctic Earth Sciences, Adelaide, Australia, August 1982.

Halpern, M. and G. E. Grikurov. 1975. Rubidium-strontium data from the southern Prince Charles Mountains. *Antarctic Journal of the U.S.*, 10 (1), 9–15.

Ravich, M. G. and E. N. Kamenev. 1975. *Crystalline basement of the antarctic platform*. New York: John Wiley and Sons.

Ravich, M. G. and D. S. Soloviev. 1966. Geologiya i Petrologiya Tsentralnoy Chasti Gor Zemli Korolevy Mod (Vostochnaya Antarktida) (in Russian), Tom 141, Trudy Nauchno-Issledovatelskogo Instituta Geologii Arktiki, Nedra, Leningrad.

Tingey, R. J. 1982. The geologic evolution of the Prince Charles Mountains—An Antarctic Archean cratonic block. In C. Craddock (Ed.), *Antarctic geoscience*, Madison: University of Wisconsin Press.

# Geological investigations of portions of northern Victoria Land

THOMAS O. WRIGHT

*Earth Sciences Division*
*National Science Foundation*
*Washington, D.C. 20550*

As part of the 1982–1983 West German Antarctic northern Victoria Land Expedition (GANOVEX-III), I participated in field work in the lower Mariner Glacier area from 15 January until 1 March 1983. The purpose of the expedition was to investigate the general geology, structure, geochemistry, and geophysics of selected portions of northern Victoria Land. This preliminary report is restricted to work done in the Malta Plateau area with Michael Schmidt-Thome of Bundesanstalt für Geowissenschaften and Rohstoffe (BGR) and Greg Mortimer of the Canterbury University, Christchurch and from the Handler Ridge area with Bob Findlay of Hobart University, Tasmania. A more complete account will appear in the *Geologisches Jahrbuch*, published by BGR (Mortimer, Schmidt-Thome, and Wright in press; Wright and Findlay in press).

GANOVEX-III was based on board the *Polar Queen*, an ice-strengthened ship of Norwegian registry. Four Hughes 500D helicopters provided air support for all field projects and field camp logistics. Two field camps were established in the Mariner Glacier area, one at Spatulate Ridge (73°27'S 167°15'W) and one at Lawrence Peaks (72°50'S 166°15'W). Coastal fog and stormy weather limited flyable days to approximately one-third of the time we were in the area. However, the exceptional versatility and maneuverability of the Hughes 500D helicopters helped us make very efficient use of the good weather days.

The purpose of investigations in the Malta Plateau area was to attempt to locate the eastern edge of the Bowers Structural Zone, which was expected to be somewhere between Bunker Bluff and Cape Crossfire based on projection of the trend of the Leap Year fault southward from the Millen Range. Leap Year quartzite was found as far east as Tur Peak while Robertson Bay rocks were found on Clapp Ridge. Although these findings do not allow any analysis of structural relationships between the Bowers Supergroup rocks and the Robertson Bay Group rocks, it does confirm that the Bowers structural zone does indeed continue through to the Ross Sea following approximately the same trend as it has inland. The Malta Plateau and a large area


**Sketch map showing northern Victoria Land and localities mentioned in text.**