Proterozoic Rocks

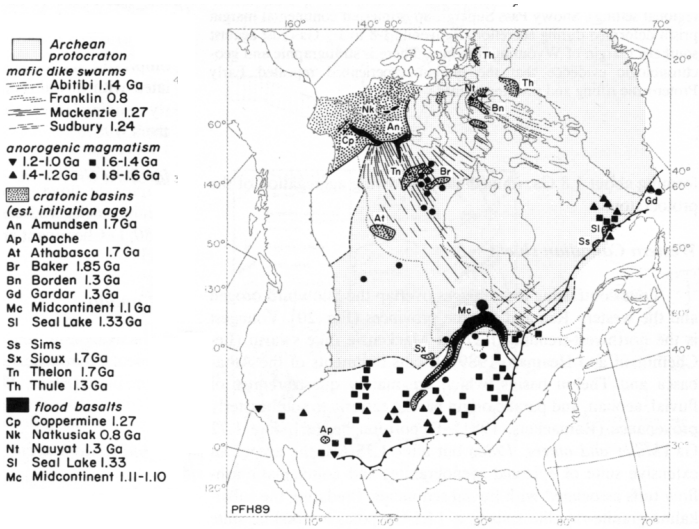
Chapter 15B

Proterozoic Terrain

- 2.5 to 0.57 Gy old
- Basaltic intrusions
- Anorthosite massifs
- Linear belt overprints

Basaltic Intrusions

- Dike swarms are common
- Suggest widespread horizontal extension
- In Canadian shield dikes migrated outward



Layered Mafic Intrusions

- Great Dyke, Zimbabwe
- Duluth Gabbro, MN (1.2 Gy)
- Muskox intrusion, NW Territory
- Sudbury, Ontario (1.7 Gy)
- Bushveld Complex, S. Africa (2.1 Gy)

Origin of Proterozoic Mafics

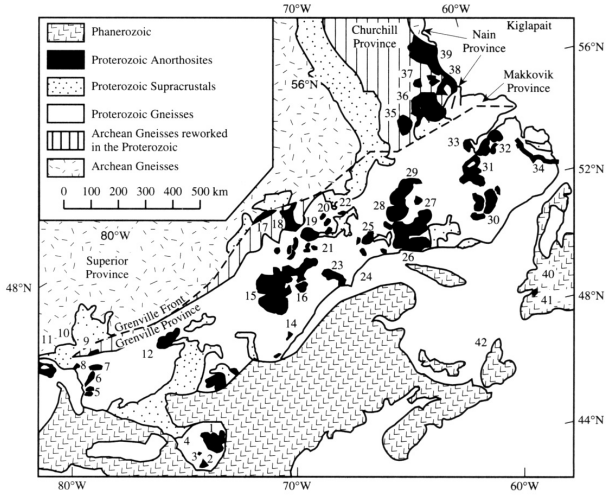
- The result of meteorite impacts?
- If so, why?

Anorthosite Massifs

- **Largest volumes as Proterozoic massifs**
- **Surrounded by high-grade granulites**
- **Occur as sheets a few km thick**

Anorthosite Suite

- **Anorthosites**
- **Gabbro, norite, leucogranite also**
- **Ultra mafic rocks are missing**
- **Mafic phases are anhydrous**



Crystallization Conditions

- **Anhydrous mafic assemblage suggests low water pressure**

Hbld + Biot + Qtz = Hyper + K-spar + Plag

- **Plagioclase is generally andesine, not labradorite as in Archean mafic suites**
- **High T contact aureoles**
  - **Suggest P < 0.5 GPa**

Origin of Anorthosite

- Crystallization temperatures 1000 - 1200°C
- Large Eu anomaly indicates magmatic
- Anorthosites are cumulates with plagioclase magacrysts
- Are the felsic charnokites co-magmatic?
  - Different Sr ratios from anorthosites
- Concentrated in space and time ~1.4 Gy

Rapikivi Granites

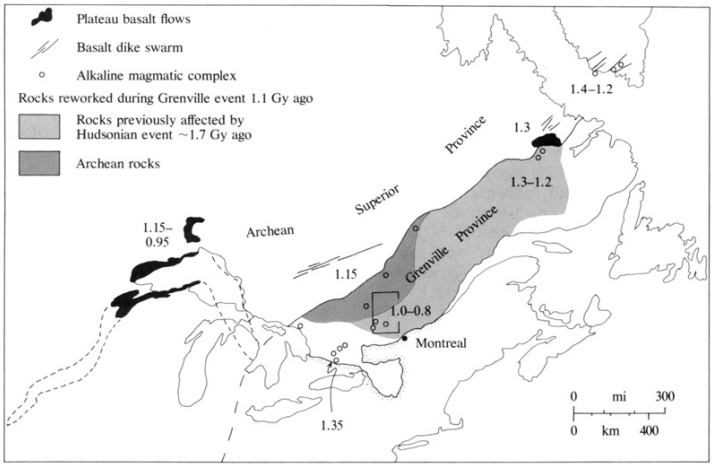
- Felsic member of the anorthosite suite
- Anhedral K-spar surrounded by rims of sodic plagioclase
- Ages of 1.1 to 1.7 Gy
- Some emplaced at a shallow crustal level
- Locally associated with volcanic equivalents

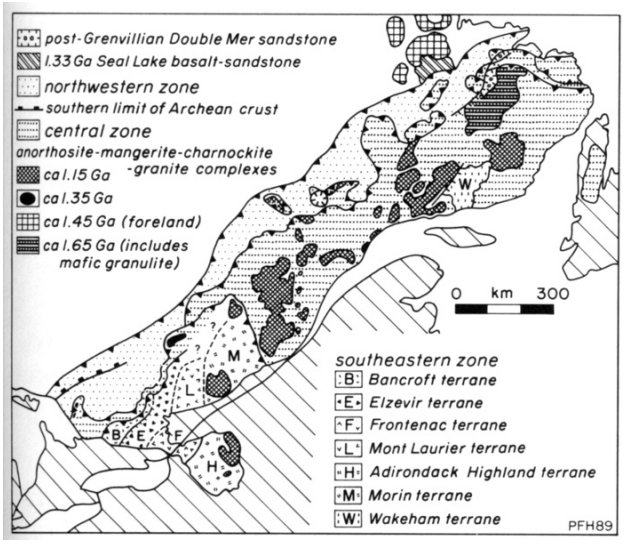
Proterozoic Mobile Belts

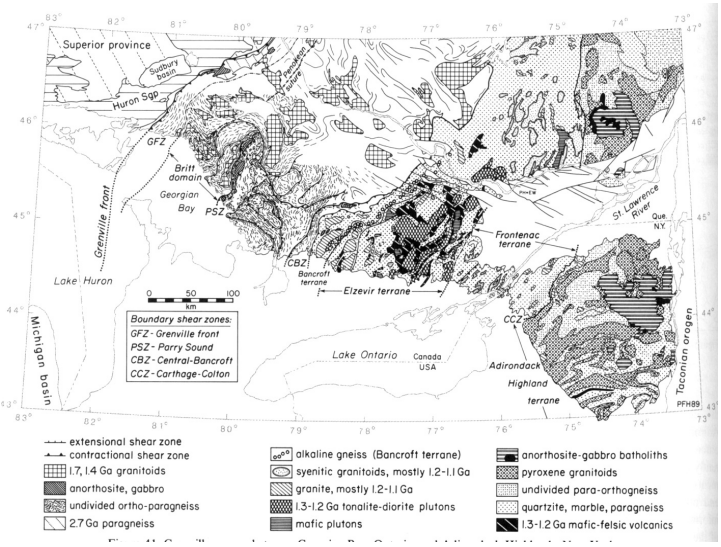
- Differ from orogenic belts
- Origin as ensialic reworking of materials
  - No new materials involved
- Form by suturing of small blocks
- Typical of Proterozoic terranes
- Examples:
  - South Africa
  - Grenville

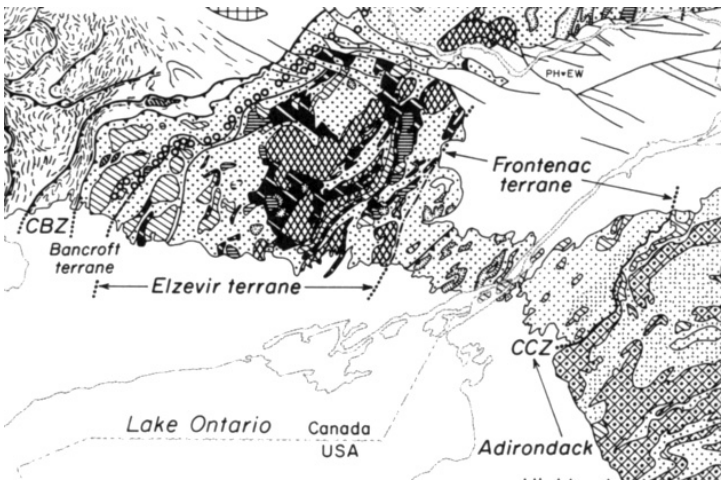
Grenville Province

- **Peripheral to Archean terrane**
- **Rests on sialic basement**
- **Basal submarine basalts overlain by calc alkaline volcanics**
- **Folds overturned toward Archean terrane**









Bancroft Terrane

- Middle to upper amphibolite grade marble
- Siliciclastic sediments
- Granodiorite/orthogneiss
- 1.1 Ga nepheline syenites
- Carbonatite
- Thrusting at base of southern zone
- High grade metamorphism of the central zone

Elzivir Terrane

- Greenschist and amphibolite grade metavolcanics
- Marble and siliciclastic sediments
- Tholeiitic and calc-alkali volcanic rocks
- ~1.3 GA tonalites and granites
- Peralkaline volcanics and plutons

Frontenac Terrain

- Lacks metavolcanics and tonalites
- Contains marble and siliciclastic sediments
- Amphibolites to granulites
- SE dipping foliations
- ~1.2 gabbro-syenite-granite plutons

Adirondack Terrane

- Mylonite zone at NW contact with Frontenac
- Large anorthosite-gabbro-charnockite complexes
- Siliciclastic, carbonate, and evaporite metasediments
- Felsic metavolcanics
- 1.3 – 1.1 Ga intrusions

Grenville Controversies

- **Anorthositic complexes?**
- **Nature of contact with Superior province**
  - **The Grenville Front**
- **Extensive granulate facies rocks**
  - **Suggest 60 km crust during formation**

Evidence for Grenville Origin

- **Rifting at the start of the Grenville**
  - **Plateau basalts**
  - **NE trend of dike swarms**
- **Deformation and metamorphism ~1.1 Gy**
- **Probably represents the opening and closing of an ocean**
- **Rapikivi granites ~1.4 Gy represent rift related bimodal facies**

Late Proterozoic Rifting

- Late Proterozoic rifting began ~0.8 Ga
- Continental breakup occurred ~ 0.6 Ga
- St. Lawrence represents a failed rift of this period
- Alkali intrusions associated with this rifting