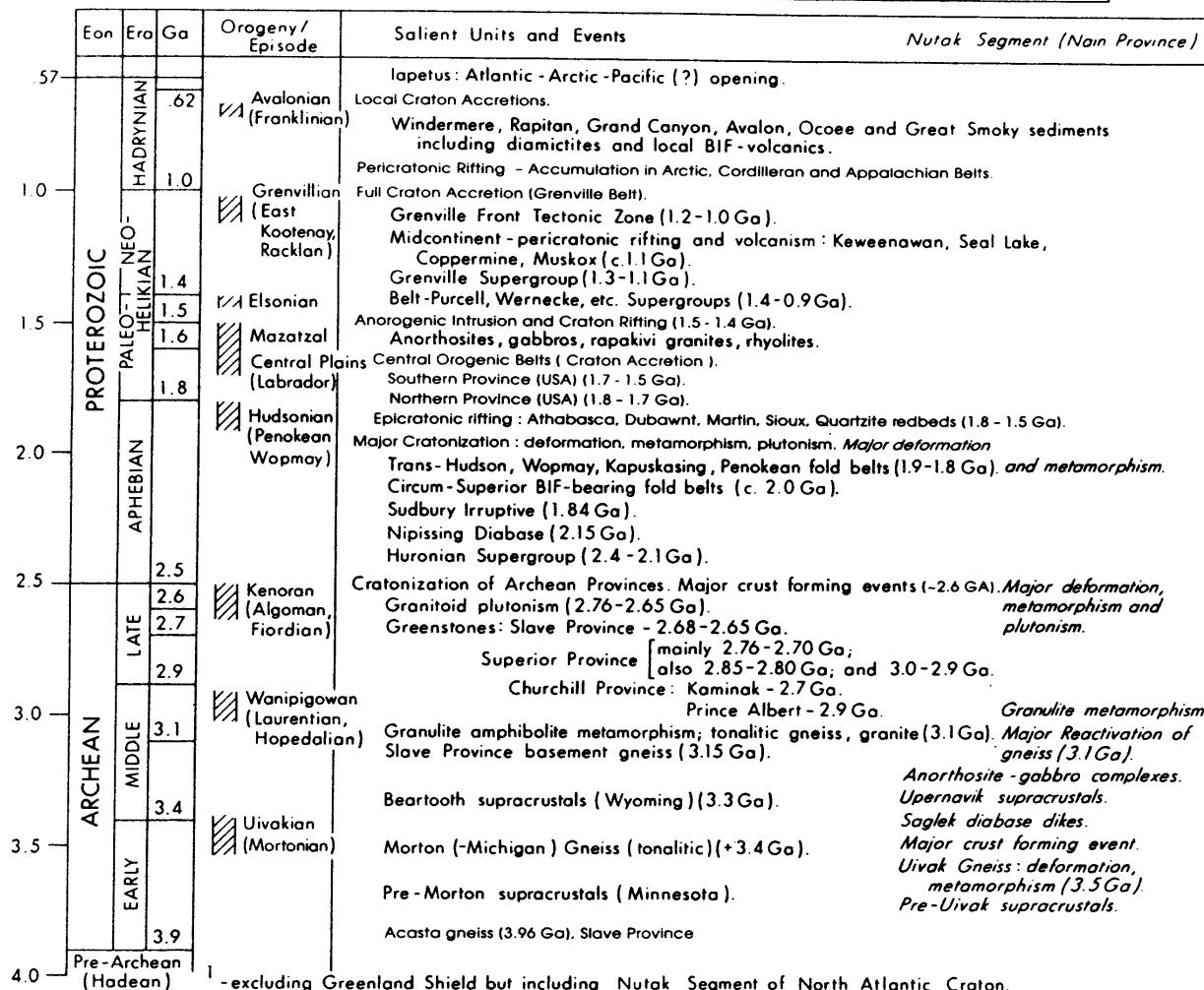
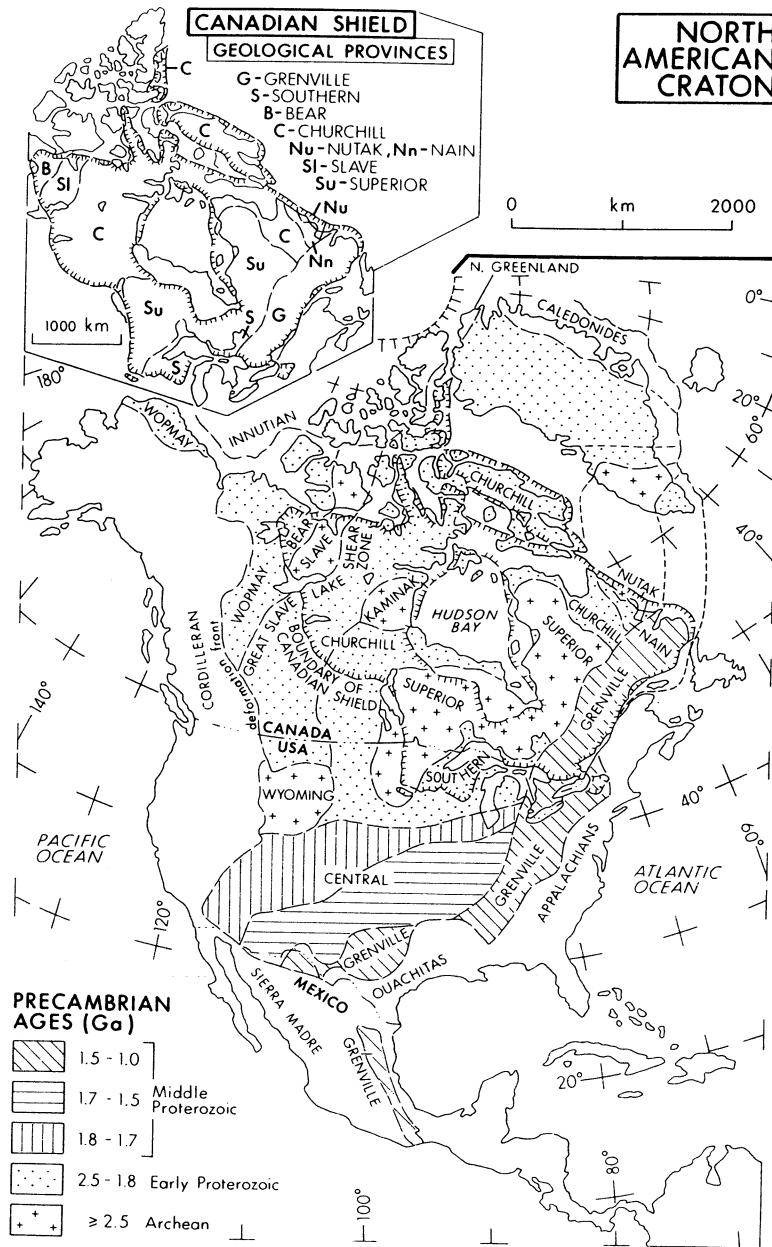


## OROGENIES AND TECTONIC CYCLES

## **NORTH AMERICAN CRATON | LESS GREENLAND SHIELD**



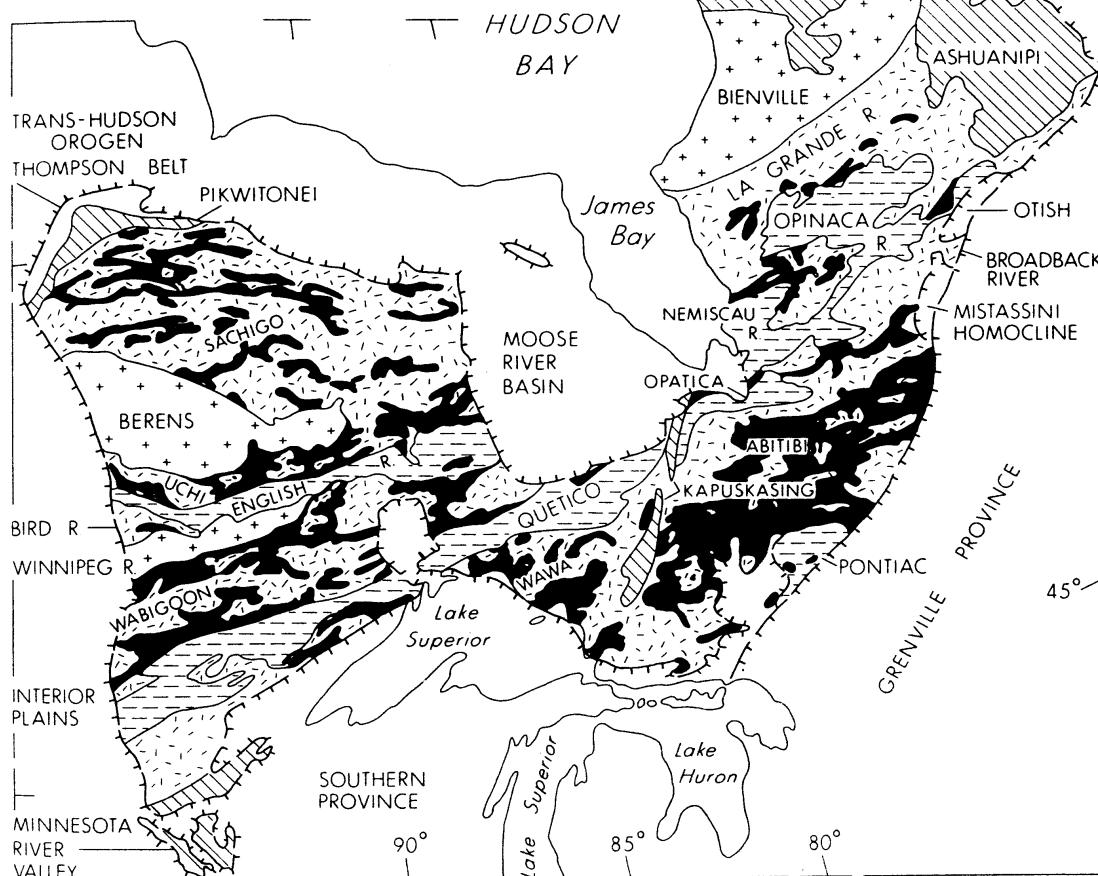
**Fig. 1-3d(ii).** Summary chrono-stratigraphic development of Precambrian crust of the North American Craton excluding Greenland Shield. Salient crustal units and events are arranged in relation to internal orogenies and resulting tectonic cycles.



ARCHEAN SUBPROVINCE TYPE

- [+ +] Plutonic
- [+ -] Volcanoplutonic
- [---] Metasedimentary
- [\ \ \ ] High grade gneiss
- - - Proterozoic, Phanerozoic rocks
- - - Subprovince boundary

300 km



**Fig. 2-5.** Map of Superior Province showing volcanic-plutonic, metasedimentary-gneiss and plutonic subprovinces or superbelts and other subdivisions. (From Card, 1990. Published with permission of the author).

**Table 2-6. Lithologic proportions of Archean crust in Superior Province, Canadian Shield.**

Lithologic unit	(1) Ungava Domain (%)	(2) Western Superior Province <sup>1</sup> (%)	(3) Average Superior Crust (%)
(1) Banded gneiss, granitic gneiss, migmatite	66	36	50
(2) Massive to slightly foliated granitoids	24	38	31
Tonalite-granodiorite	24	32	28
Granite-leucocratic	0.4	6	3
(3) Paragneiss, veined gneiss, migmatite	9	9	9
(4) Mafic to ultramafic intrusions	0.1	1	1
Metasupracrustal rocks	1	16	9
Volcanic rocks	—	11	6
(5) Sediments	—	5	3
Size of area (km <sup>2</sup> )	498 000	~231 000	1 572 000

<sup>1</sup>Weighted average of (a) Red Lake-Landsdowne, (b) Geotraverse and (c) Berens-Sachigo areas  
Adapted from Goodwin (1978)

**Table 2-7. Average proportions of metamorphic facies in Superior Province, Canadian Shield.**

Metamorphic facies	Percentage of total area (1 572 000 km <sup>2</sup> )
Granulite	22
Amphibolite	66
Greenschist	11
Subgreenschist	1
	100

Adapted from Goodwin (1985)

### Ungava Craton

Our knowledge of this large region (498 000 km<sup>2</sup> extending from Hudson Bay on the west to the La  
rador Trough on the east and from Cape Smith Be  
on the north to East Main River (James Bay) vicir  
ity on the south (Fig. 2-5), is based on reconna  
issance studies (Eade 1966, Stevenson 1968) sup  
plemented by recent local studies (Skulski et a  
1984, Avramtchev 1985, Percival and Girard 1988  
Percival et al 1992, 1994, Stern et al 1994). Bed  
rock geology is dominated by granitoid rocks of a  
least five plutonic suites, both foliated and massive

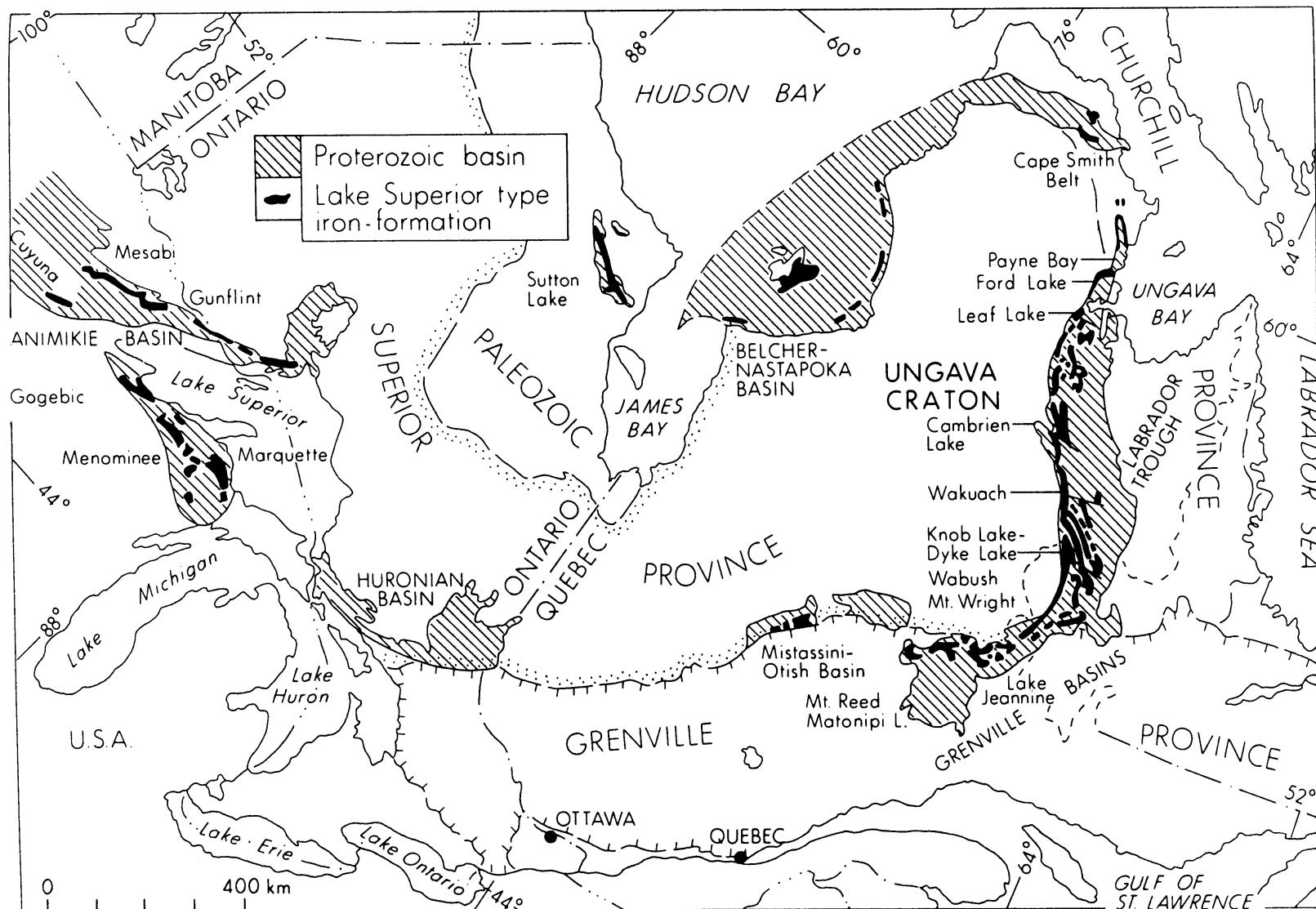
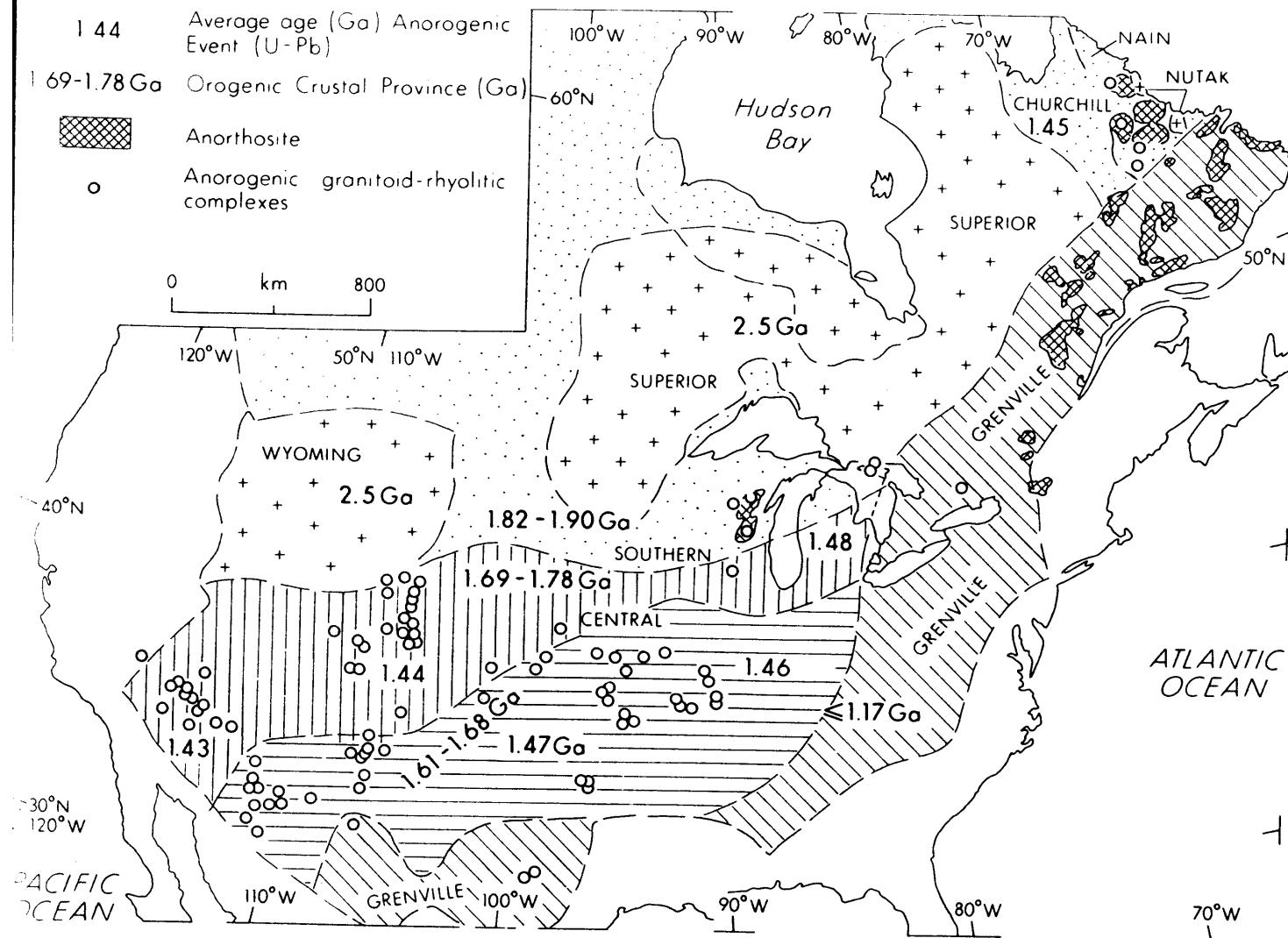
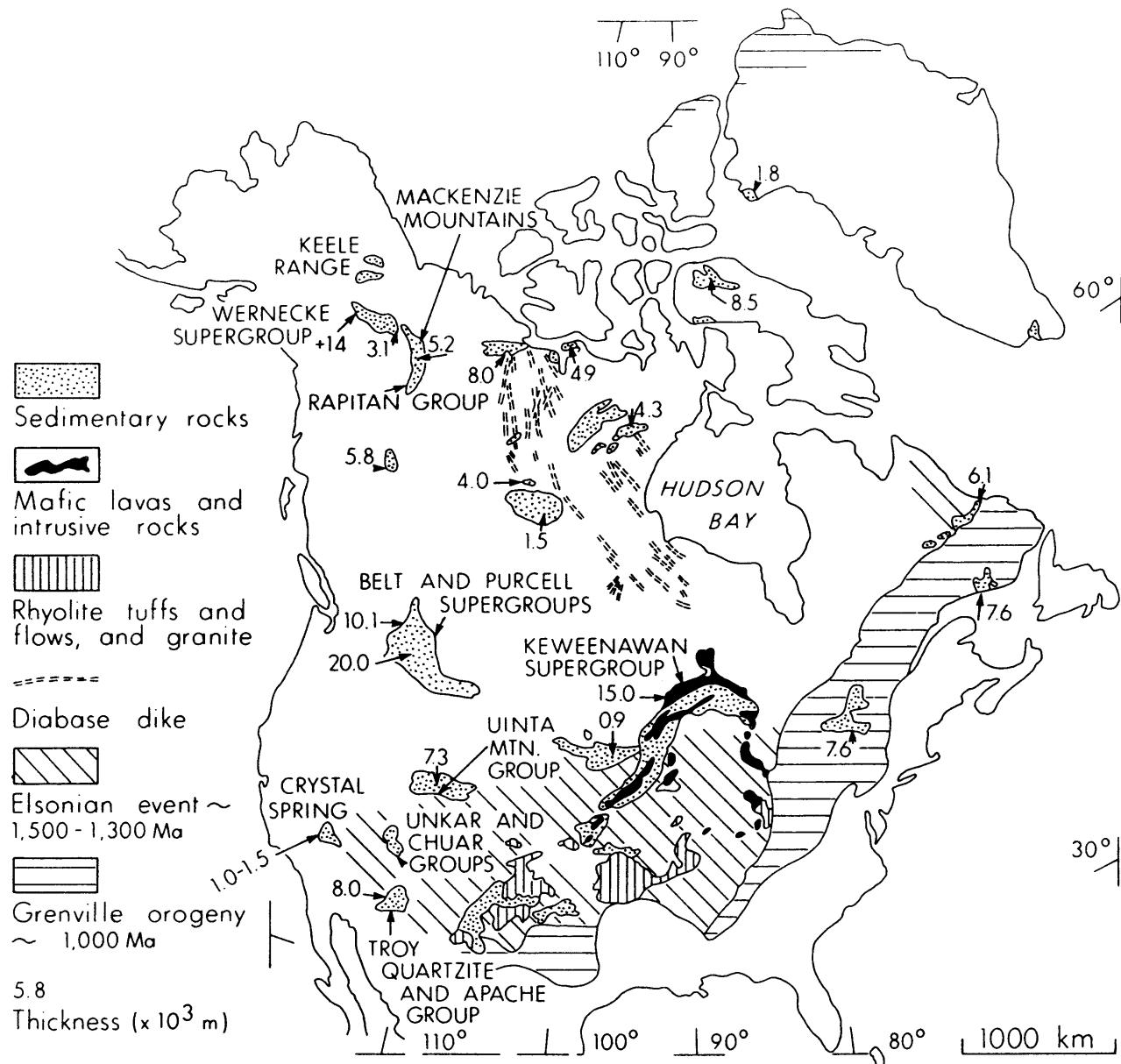


Fig. 3-8. General distribution of iron formation in early Proterozoic fold belts marginal to the Ungava Craton. (After Gross and Zajac 1983, Fig. 6-1, and reproduced with permission of the authors and of Elsevier Science Publishers).



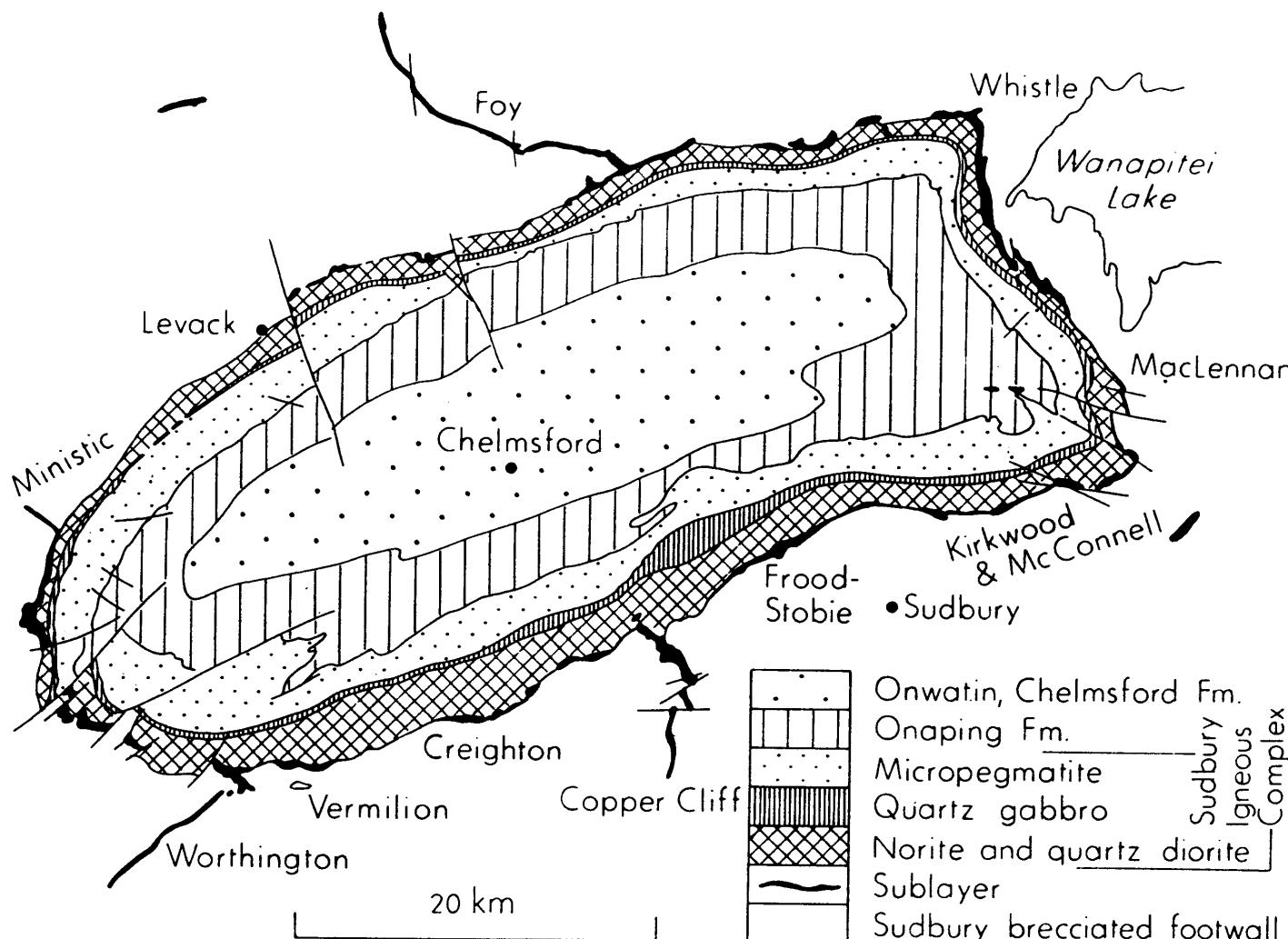
**Fig. 4-7.** Distribution of mid-Proterozoic orogenic provinces (Central Belts and Grenville Belt) and of anorogenic intrusions, (anorthosites and granitoid-rhyolitic complexes) in relation to older Precambrian subdivisions of North America. (Adapted from Anderson 1983, Fig. 1, and reproduced with permission of the author and of the Geological Society of America).



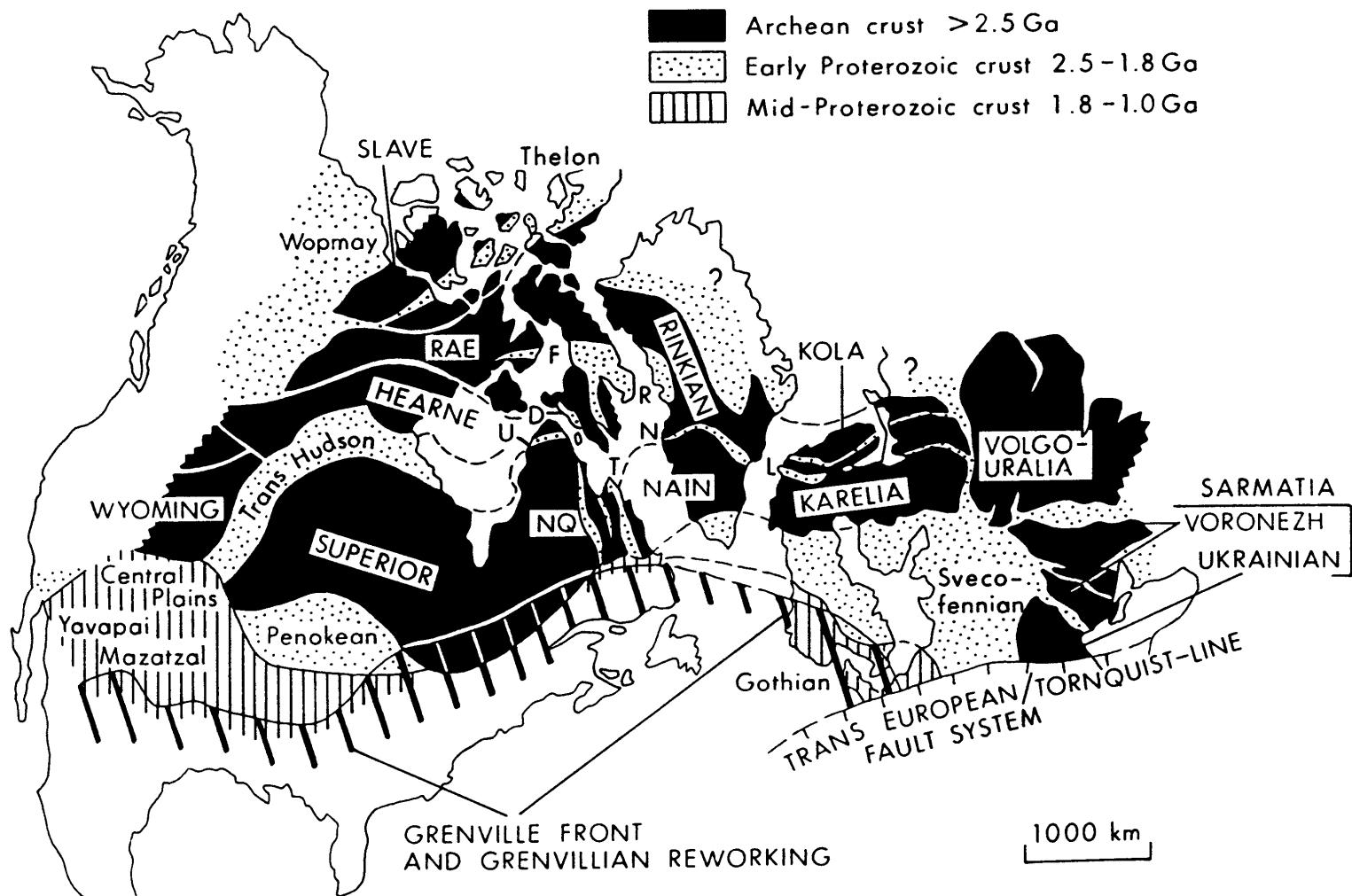
**Fig. 4-11.** Generalized distribution of mid to late Proterozoic rocks (1700–850 Ma) in the North American Craton. (From Stewart 1976, Fig. 1, and published with permission of the author).

## NORTH AMERICAN CRATON (LESS GREENLAND SHIELD)

1

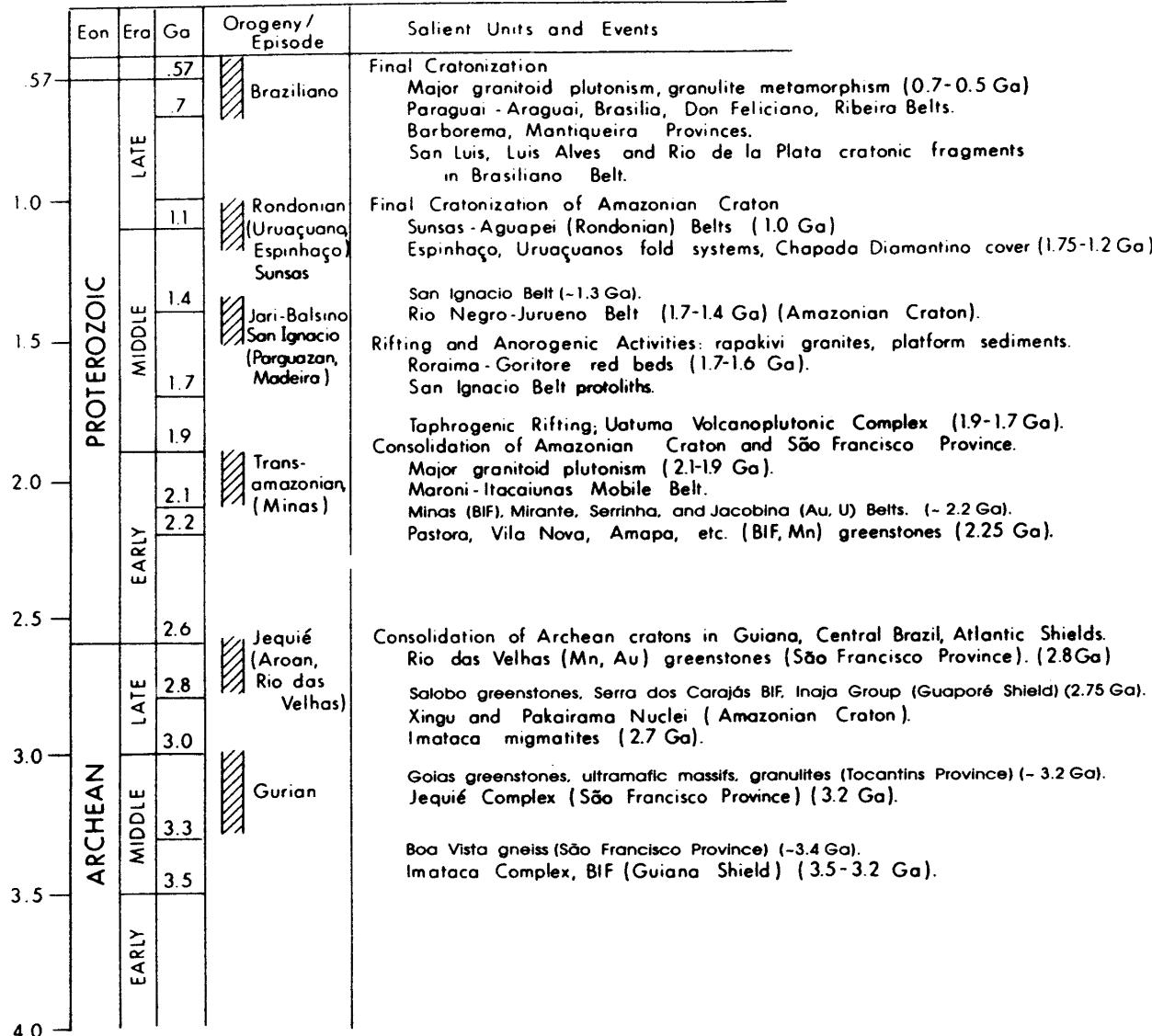


**Fig. 3-5.** Sketch map of the Sudbury Igneous Complex showing the distribution of the complex, sub-layer, brecciated footwall, and enclosed Whitewater Group. (Adapted from Grand and Bite 1984, Fig. 12.1, and reproduced with permission of the Ontario Geological Survey)



**Fig. 3-2.** North Atlantic Precambrian reconstruction showing pre-Grenvillian craton configurations as discussed in the text (after Gorbatschev and Bogdanova, 1993, Fig. 4). The letter symbols are: NQ – New Quebec; U – Ungava; D – Dorset; F – foxe; R – Rinkian; N – Nugssugtoqidian; T – Torngat; L – Lapland Granulite Belt.

## SOUTH AMERICAN CRATON



**Fig. 1-3e.** Summary chrono-stratigraphic development of Precambrian crust of the South American Craton. Salient crustal units and events are arranged in relation to internal orogenies and resulting tectonic cycles.

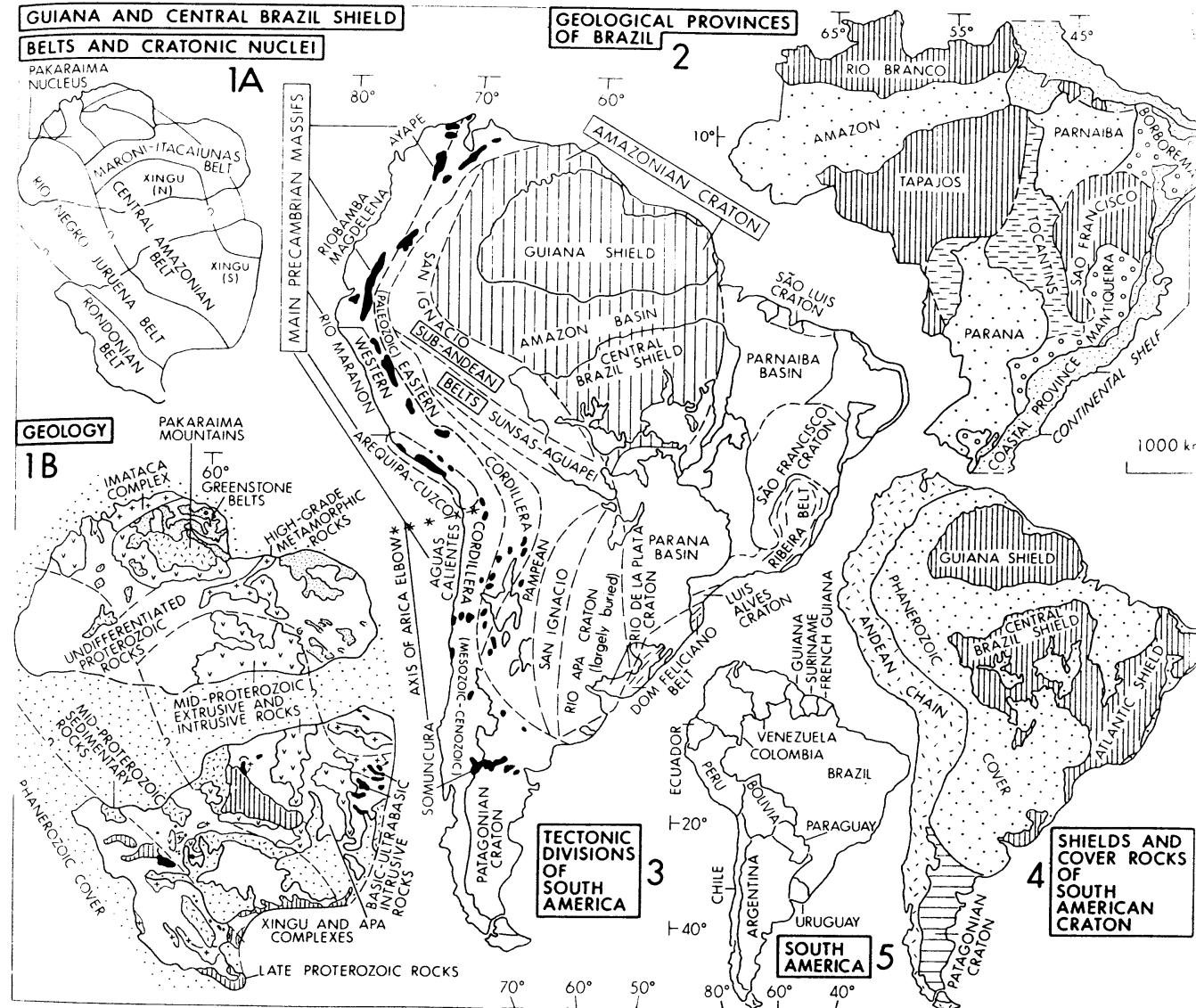
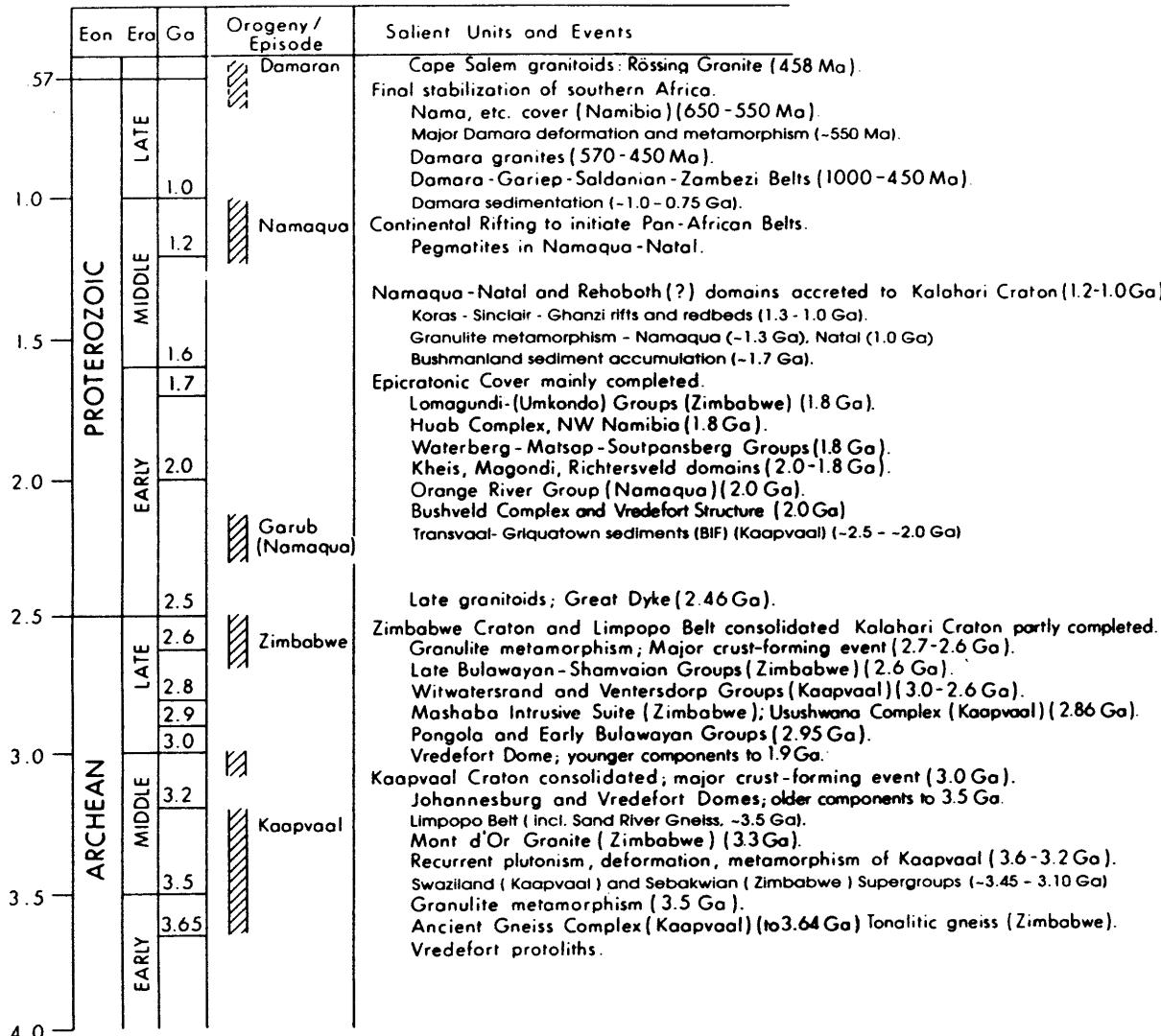


Fig. 1-5e. Main geologic outline and divisions of the South American Craton showing (1) Guiana and Central Brazil shields; (2) geological provinces of Brazil; (3) tectonic divisions of South America; (4) shields and cover rocks of the platform; (5) political division of South America (adapted from Almeida et al 1981, Figs 1, 2, 3; Litherland et al 1985, Fig. 4; Gibbs and Barron 1983, Fig. 1; and Hasui and Almeida 1985, Fig. 2).

# AFRICAN CRATON

## (1) SOUTHERN AFRICA



**Fig. 1-3f(i).** Summary chrono-stratigraphic development of Precambrian crust of the African Craton—southern Africa. Salient crustal units and events are arranged in relation to internal orogenies and resulting tectonic cycles.

## AFRICAN CRATON

### (2) CENTRAL - NORTHERN AFRICA

Eon	Era	Ga	Orogeny / Episode	Salient Units and Events
57				Final cratonization of Craton.
1.0		6 .88	Pan-African (West Congolian; Pharusian)	Submeridional faulting of Tuareg Shield. Climax of Pan-African Orogeny (650 -550 Ma); Bou Azzer ophiolite. West Africa -Tuareg Wilson Cycle (782 -578 Ma).
1.0		1.0		Plate collisions and island arc accretions (Arabia -Nubia ) (790 -675 Ma ).
1.0		1.1	Katangan	Recurrent tectonism throughout Pan-African intracontinental mobile belt network (1.1-0.5 Ga). Pharusian Belt (1.1-0.5 Ga). Basal beds in Taoudeni and Congo Basins (1.0 Ga).
1.5		1.3	Kibaran	Katangan; West Congolian, Mozambique, etc. sequences (1.1-0.6 Ga). Continental rifting and initiation of Pan-African Cycle (1.1 Ga). Darfur-Tchad Gneiss (1.2-1.1 Ga) Aleksod Group (-1.0 Ga). Post-Kibaran granitoids (to 1.1 Ga). Main Kibaran Event (1.3 Ga).
2.0		1.75		Kibaran (-Burundian -Karagwe - Ankolean), Irumide, and Lurio Belts (1.35-1.1 Ga). Zadinian Group (W. Congo) (+1.2 Ga).
2.0		2.1	Eburnean (Ubendian; Suggarian; Tadian; Hubian)	Widespread consolidation of African Continent (1.95-1.75 Ga). Post-orogenic, anorogenic magmatism - granitoids, syenites and volcanic complexes. Tarkwaian molasse (W. Africa) (2.0 Ga). Kunene Anorthosite (Angola) (2.1 Ga).
2.5		2.5		Main Eburnean Event (2.1-1.95 Ga). Widespread cratonization. Major crust-forming event. Kimezian Group; Francevillian sediments (W. Congo); Anti-Atlas Gneiss. Ruzizian -Ubendian -Rwenzori -Usagaran belts (Zambia -Tanzania ). Birimian -Yetti volcanosediments (W. Africa); Arechchoum Gneiss (Hoggar) (-2.1 Ga). Luizian metasediments (Kasai); Angola - Zambian cover sequences. Cratonization of Archean nuclei (2.5 Ga).
3.0		2.9	Liberian (Moyo, Aruan )	Upper Kibalian and Kavirondian greenstones (+2.5 Ga). Dibaya (Kasai) and Jebel -Uweinat Gneiss - Migmatite (-2.5 Ga).
3.0		3.2	Watian (Musefu; Leonean)	Granulite metamorphism; crust-forming event (~2.9 Ga). Lower Kibalian, Nyanzian and Liberian greenstones (+2.9 Ga). Bomu -Nzangi Gneiss.
3.5		3.5	Bomu	Bandas (Gabon) and Loko (W. Africa) greenstones (+2.9 Ga). Ghallaman, Chegga and Amsaga Gneiss (W. Africa) (-3.2 Ga). Early Ganguan greenstones. Granulite metamorphism; tonalite (Bomu); Luanyi Gneiss (Kasai); Red Series (Hoggar); Antogil Gneiss (Madagascar) (3.5 -3.4 Ga).

**Fig. 1-3f(ii).** Summary chrono-stratigraphic development of Precambrian crust of the African Craton—central-northern Africa. Salient crustal units and events are arranged in relation to internal orogenies and resulting tectonic cycles.

## GENERAL GEOLOGIC DIVISIONS OF AFRICAN CRATON

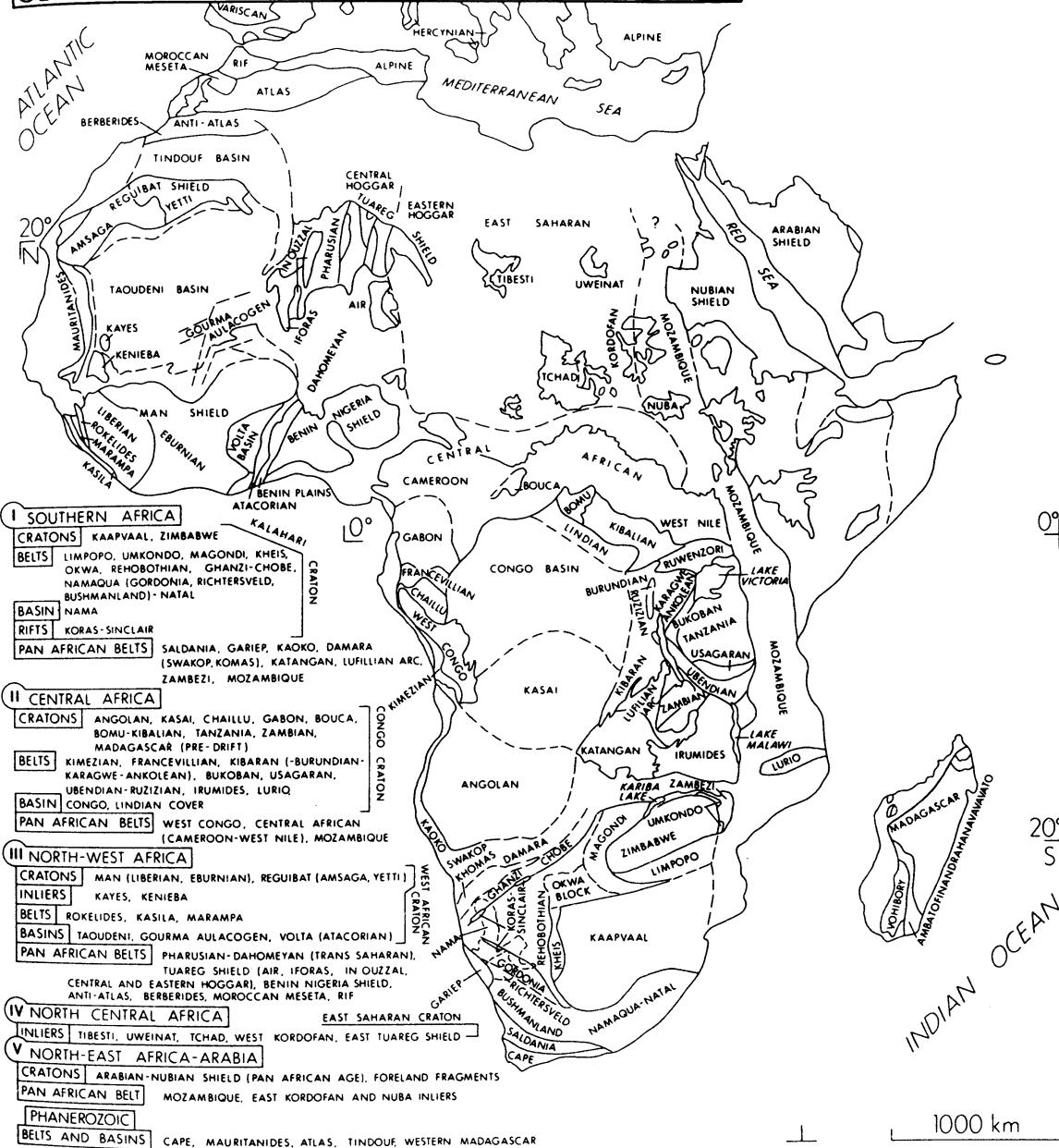


Fig. 1-5f(i)a. Main geologic outline of the African Craton showing general geologic divisions of Pre-cambrian crust (adapted from Saggesson 1978, Fig. 1).

## ANTARCTIC CRATON

Eon	Era	Ga	Orogeny/ Episode	Salient Units and Events
.57			V/1 Ross	Cambrian sediments overlie greenschist basement Greenschist Facies - Oates Land, Marie Byrd Land, Transantarctic Mountains etc. Widespread metasediments in 30°W - 45°E sector. (<0.6 Ga).
1.0		.88	6	Granulite amphibolite facies. Felsic magmatism at 1.2-1.0 Ga. Widespread reactivation including Vestfold Hills, Lutzow-Holm, Rayner Complex, etc. (1.0 Ga) Coats Land rhyolite porphyries (~1.0 Ga) Prince Charles Mts. metasediments with BIF clasts. Shackleton Range metasediments; amphibolite facies at ~1.4 Ga.
1.5		1.54	5	Granulite Facies - Dronning Maud Land, Prince Charles Mountains. Felsic magmatism in Rayner Complex (1.5 Ga). Dronning Maud Land metasupracrustals, including BIF. Mafic intrusions sparse, restricted to isolated though widespread localities.
2.0		2.4	4	Granulite Facies - Lutzow-Holm, Enderby Land, Prince Charles Mts. Rayner Complex development (2.0-1.8 Ga)
2.5			3	Granulite Facies - major resetting, Napier Complex, Vestfold Hills. Napier Complex cratonized Mainly restricted to 0°-90°E sector; other high grade gneisses Archean in part. Prince Charles metasediments Common wealth Bay, Bunker Hills, Windmill Islands, Shackleton Range lithologies.
3.0		2.9	2	Granulite Facies - Napier Complex, Dronning Maud Land, Prince Charles Mountains and Vestfold Hills metamorphism at 3.1 Ga, recumbent gneiss pile. Roggatt 'orthogneiss' and Tula 'paragneiss'; Napier Complex
3.5		3.8	1	Granulite Facies - Napier Complex, Enderby Land orthogneiss. Mount Sones Orthogneiss (3.93 Ga).

**Fig. 1-3i.** Summary chrono-stratigraphic development of Precambrian crust of the Antarctic Craton. Salient crustal units and events are arranged in relation to internal orogenies and resulting tectonic cycles.

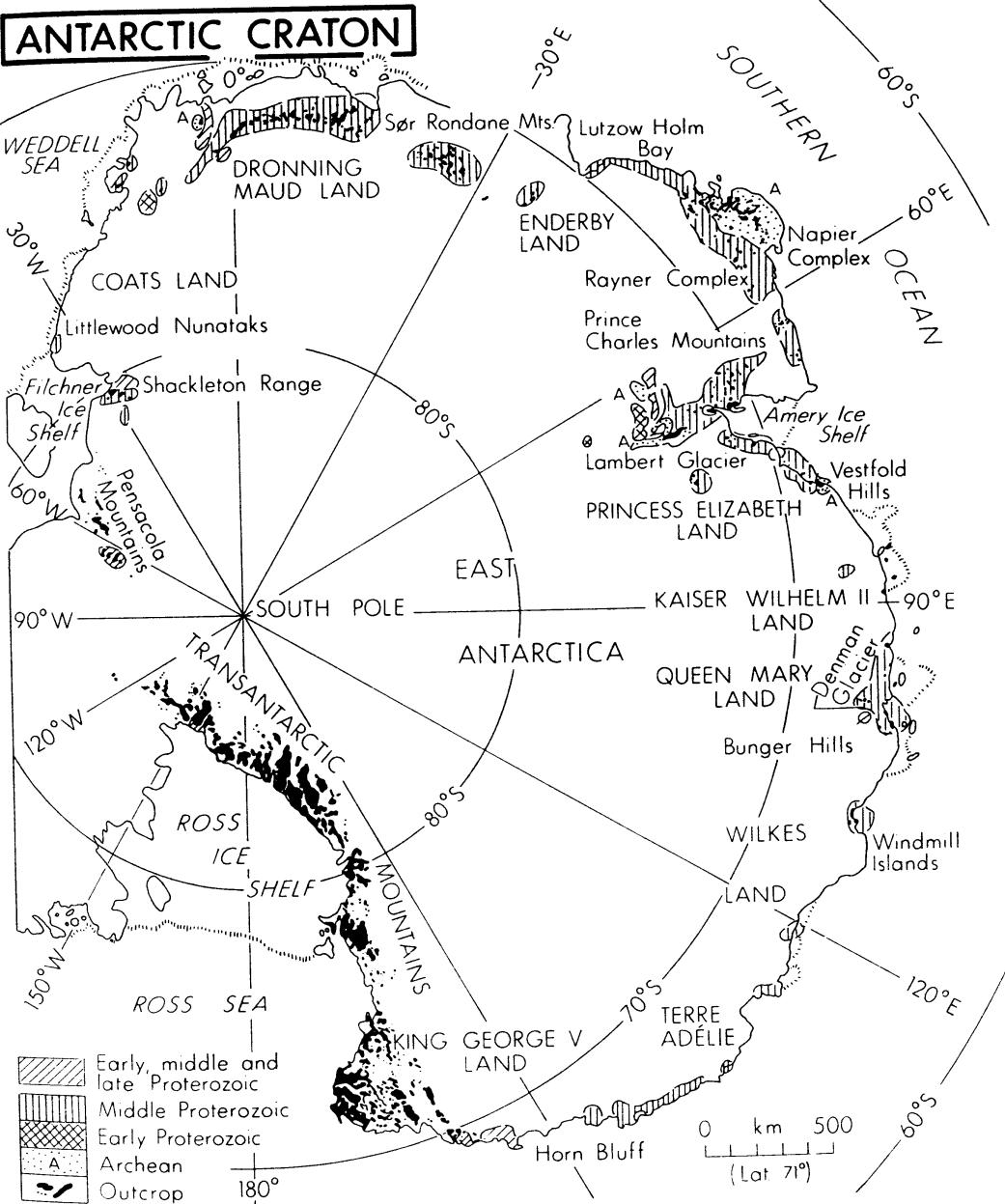
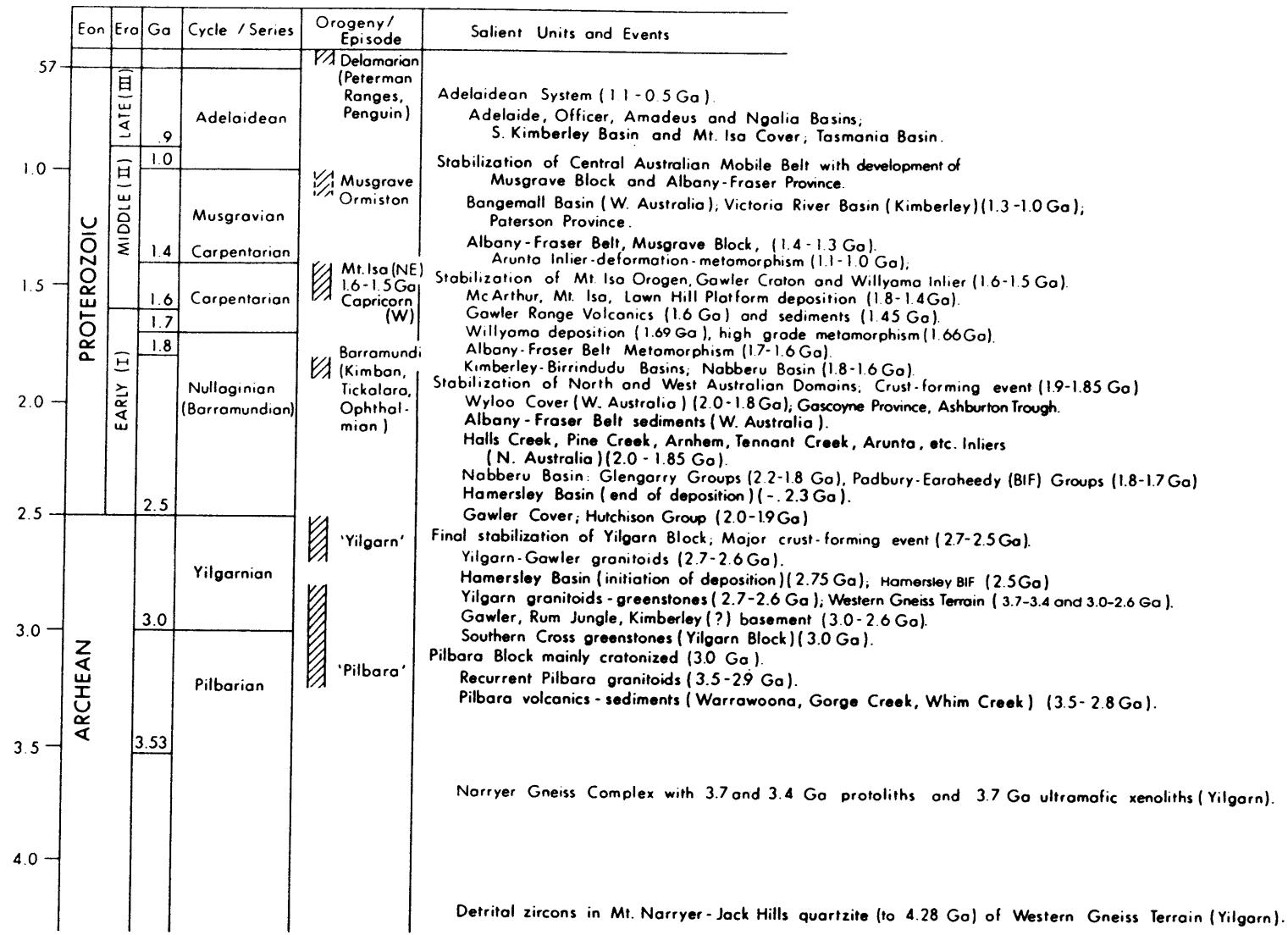


Fig. 1-5i. Main geologic outline and divisions of the Antarctic Craton (from James and Tingey 1983, Fig. 1).

## AUSTRALIAN CRATON



**Fig. 1-3h.** Summary chrono-stratigraphic development of Precambrian crust of the Australian Craton. Salient crustal units and events are arranged in relation to internal orogenies and resulting tectonic cycles.

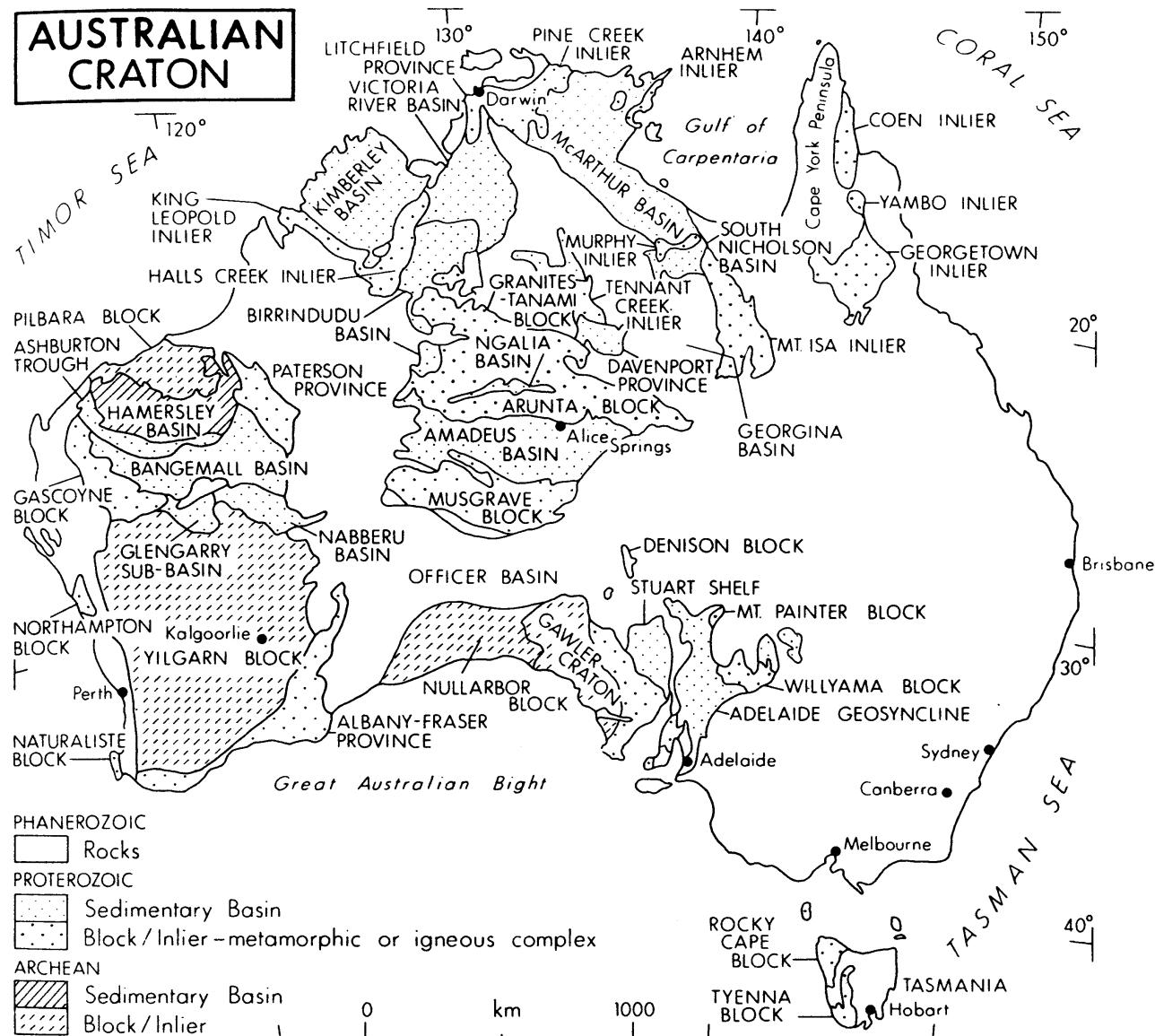
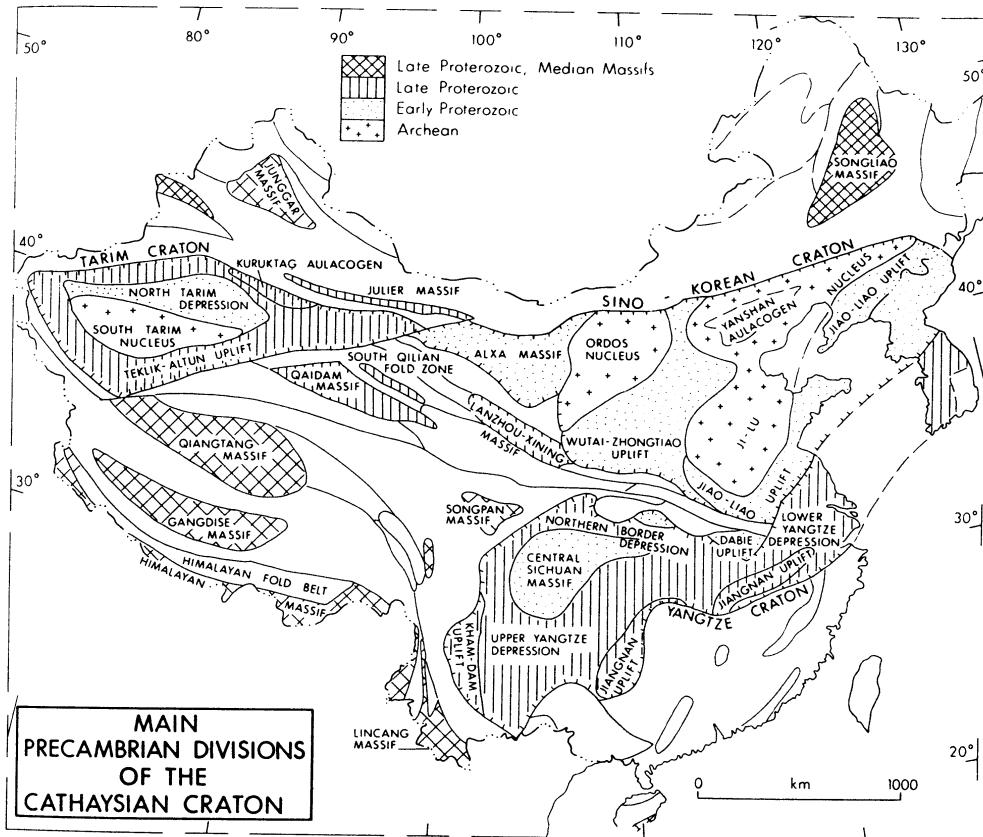


Fig. 1-5h. Main geologic outline and divisions of the Australian Craton (adapted from Wyborn 1988, Fig. 1).

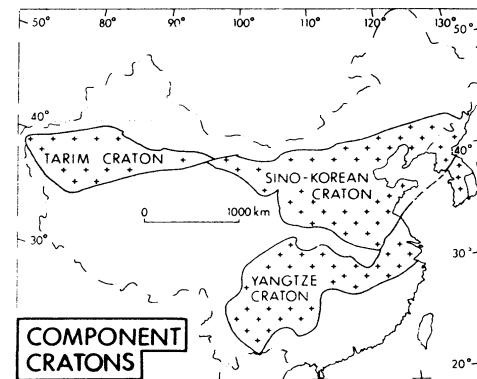
## CATHAYSIAN CRATON

Eon	Era	Ga	Cycle / Series	Orogeny / Episode	Salient Units and Events
PROTEROZOIC	LATE	85	Sinian	Jiningian (Yangtze)	Widespread Sinian Cover: lower clastics with tillites; upper argillites-carbonates. Start of Yangtze Platform Cover. Final consolidation of Yangtze Craton and northern margin of Tarim Craton. Jixian Uplift.
			Qingbaikou		Arc-trench volcanics; turbidites, ophiolites along SE Yangtze Craton. Platform sediments in northern regions.
		1.05	Jixian	Sibaoan (Wuling)	Partial cratonization of Yangtze Craton. Profound organic changes. Luanxian Uplift.
		1.4	Changcheng		Arc-trench volcanics; turbidites, ophiolites along SE Yangtze Craton.
	MIDDLE	1.85	Hutuo	Dongan	Aulacogens with clastic-volcanic fill on Sino-Korean and Tarim Cratons. Qinglong Uplift. Stable sedimentation in northern regions.
		2.2	Wutai		Final consolidation of Sino-Korean and main Tarim Cratons. Consolidation of Sichuan, etc. massifs of Yangtze Protocraton. Pronounced orogenesis; widespread metamorphism and plutonism. Hutuo (Liaohe) shelf sediments, volcanics; inc. redbeds.
		2.5	Fuping	Luliangian (Zhongtian)	Cratonicization of Sino-Korean Craton. Folding, metamorphism, plutonism. Wutai volcanics-turbidites with BIF.
		2.9	Qianxi		Consolidation of Protocontinents. Formation of Ordos and Jilu Nuclei. Granulite-amphibolite facies; migmatites; granitoid plutonism (2.6-2.5 Ga). Badaohe, Dantzi, Dengfeng etc. supracrustals (2.5 Ga). Taihua gneiss (2.8 Ga).
		3.5	Tsaozhuang	Wutaian	Granulite metamorphism; migmatites; granitoid plutonism. Qianxi, Fuping, etc. supracrustals (2.7-2.9 Ga).
ARCHEAN	EARLY	3.5	Tsaozhuang		Tsaozhuang mafic enclaves; granulite metamorphism (3.5 Ga).
		2.9		Fupingian	
		2.5			
		2.2		Qianxi (Songyang)	
		1.85			

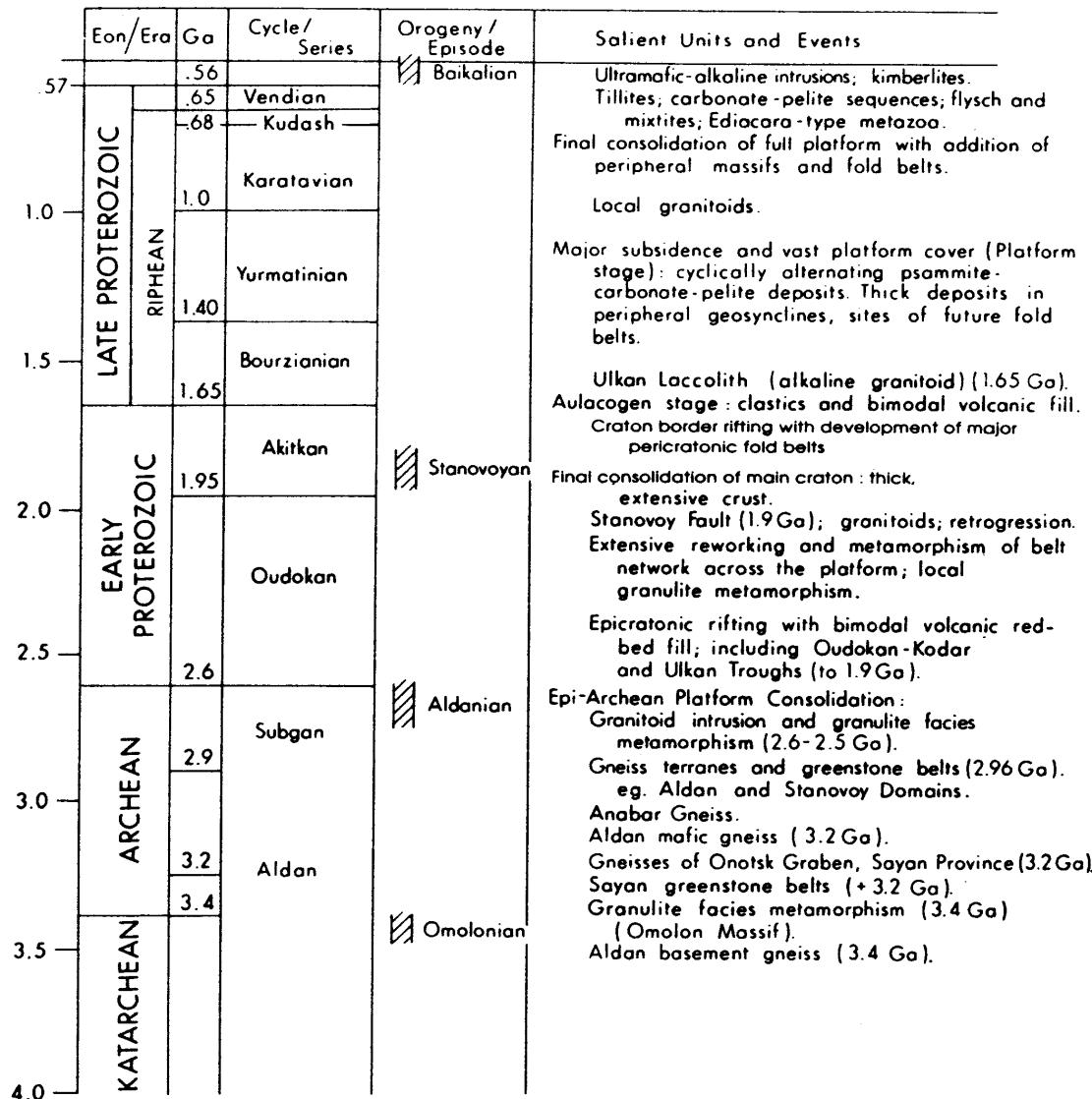
**Fig. 1-3a.** Summary chrono-stratigraphic development of Precambrian crust of the Cathaysian Craton. Salient crustal units and events are arranged in relation to internal orogenies and resulting tectonic cycles.



**Fig. 1-5a.** Main geologic outline and divisions of the Cathaysian Craton showing craton outline, main geologic features, and relevant political and geographic divisions (adapted in part from Atlas of Palaeogeography of China, 1985, Map 141).



## SIBERIAN CRATON



**Fig. 1-3b.** Summary chrono-stratigraphic development of Precambrian crust of the Siberian Craton. Salient crustal units and events are arranged in relation to internal orogenies and resulting tectonic cycles.

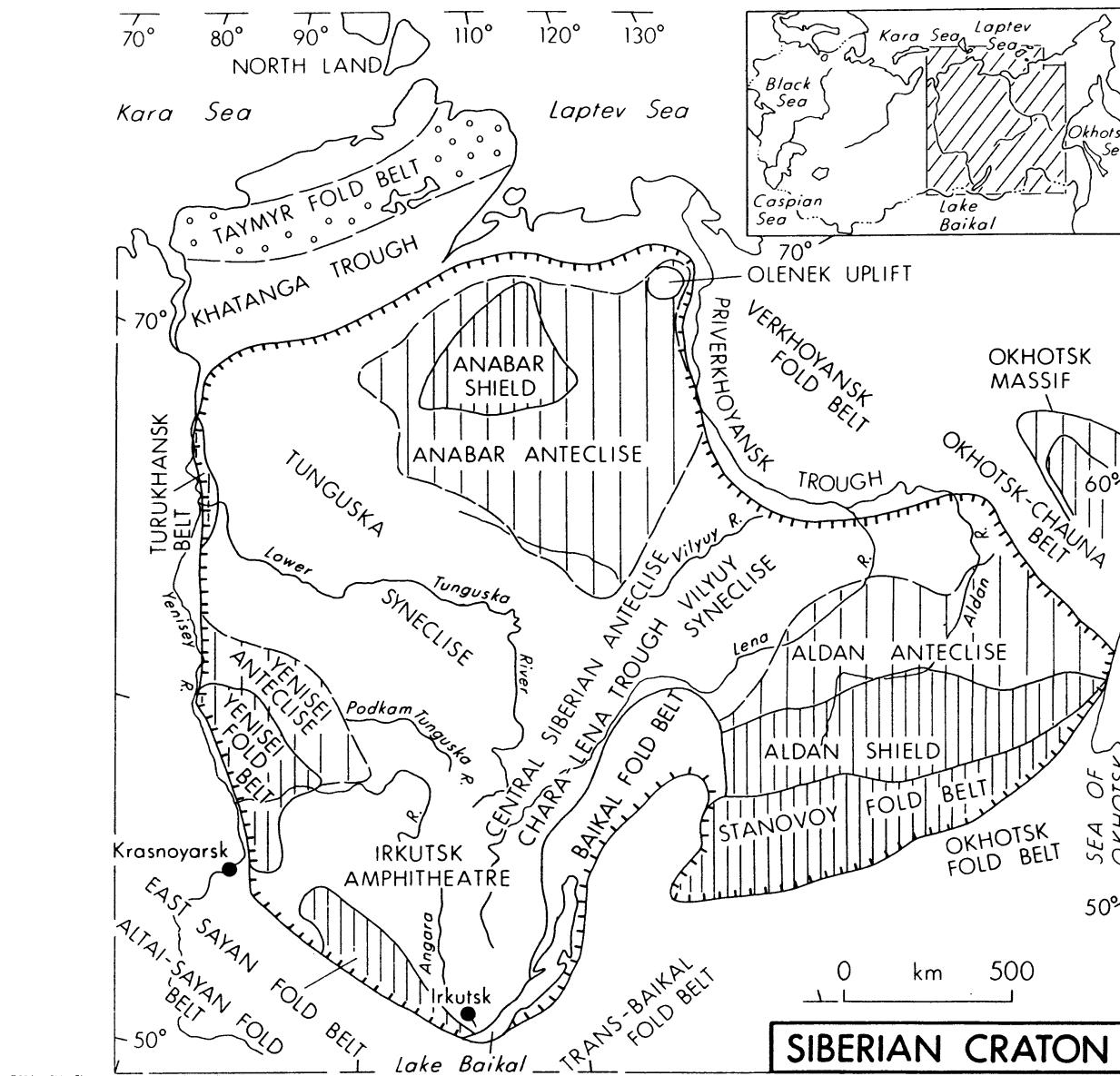
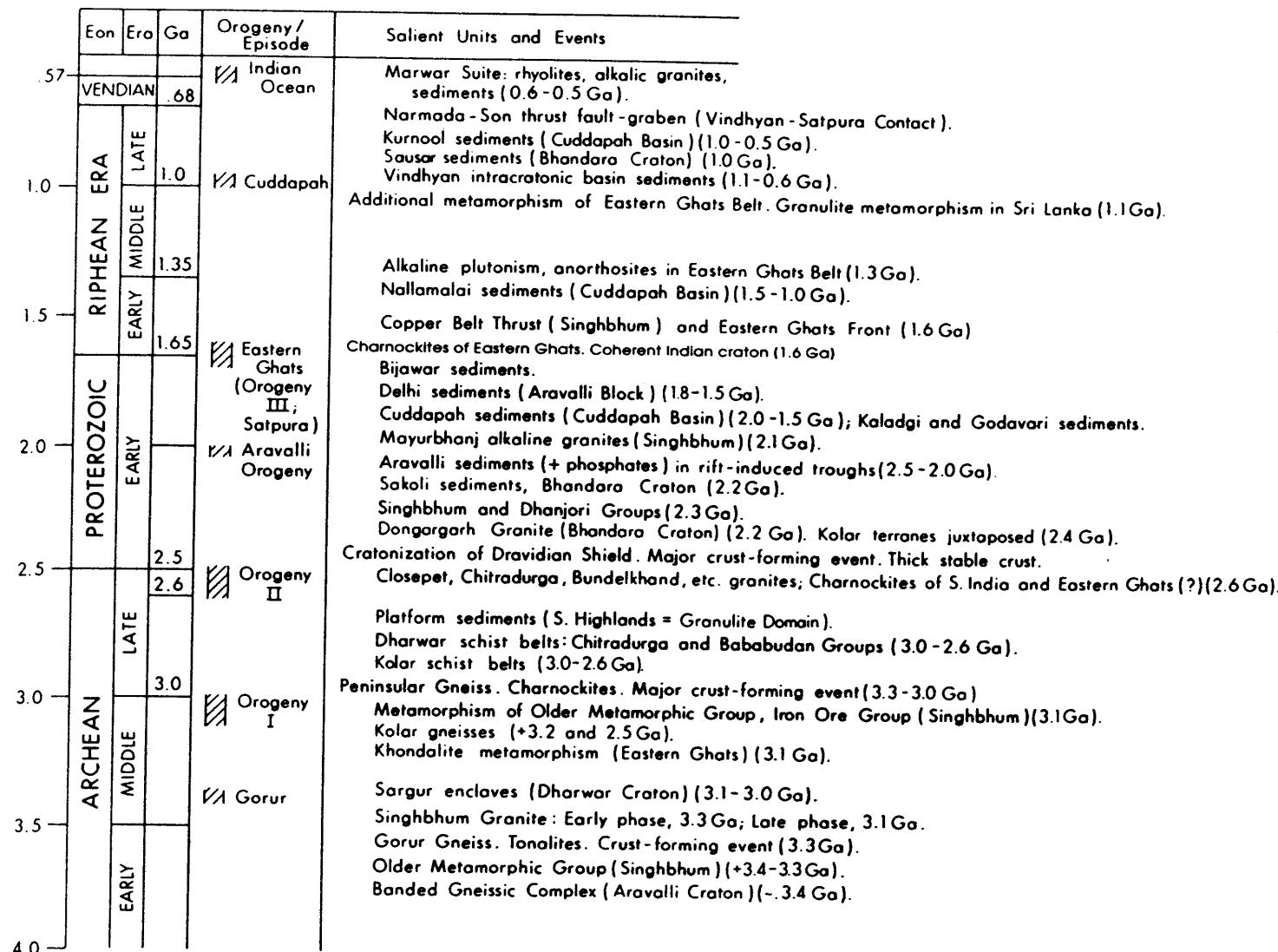


Fig. 1-5b. Main geologic outline and divisions of the Siberian Craton showing the main positive elements (exposed shields, fold-belts and adjoining anteclices) and negative elements (buried synclines and troughs) (adapted from Salop 1977, Fig. 6 and Shatzki and Bogdanoff 1961, Fig. 1).

## **INDIAN CRATON**



**Fig. 1-3g.** Summary chrono-stratigraphic development of Precambrian crust of the Indian Craton. Salient crustal units and events are arranged in relation to internal orogenies and resulting tectonic cycles.

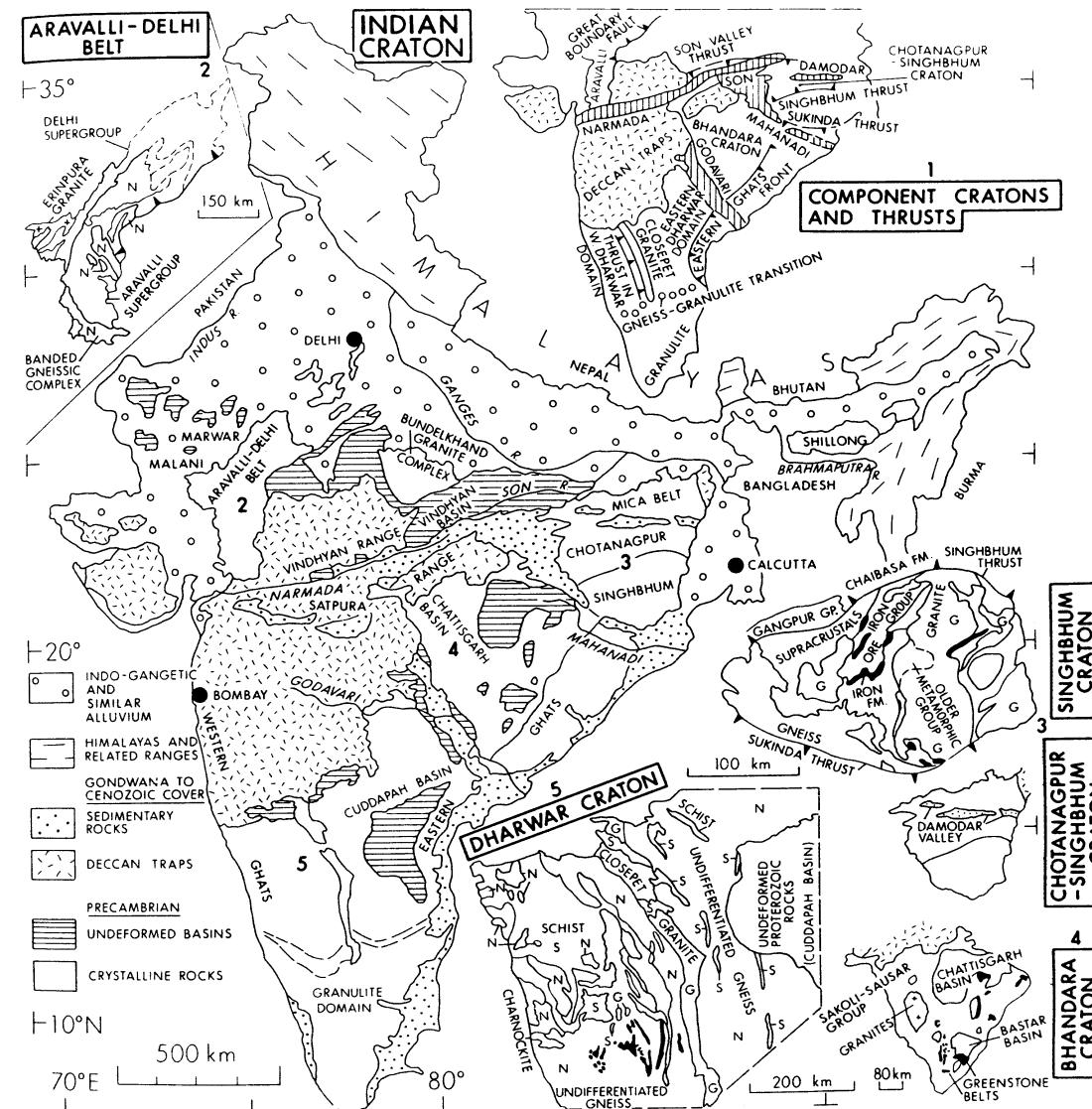


Fig. 1-5g. Main geologic outline and divisions of the Indian Craton showing main tectonic divisions; insets include (1) main cratons and thrusts, (2) Aravalli-Delhi Belt, (3) Chotanagpur-Singhbhum Craton, (4) Bhandara Craton, and (5) Dharwar Craton (adapted from Naqvi and Rogers 1987, Figs 1.1, 2.1, 3.1, 5.2, 6.1, 7.1).

