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This is one of the three abstract volumes and contains abstracts for the sessions in the Sections 1 to 10 of the Symposia II. Abstracts are arranged in the order of presentation in each session. An index of all authors in this volume is attached to the Program volume.

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IUGS Global Stratigraphic Time Scale

J.W. Cowie

Boundaries in the Global Stratigraphic Time Scale, which was presented, in provisional form, for the first time at the 28th International Geological Congress in Washington (D.C.), are based on events, rapid transitions and "phase changes" which are considered to be of world-wide significance. Boundaries between stratigraphic units have, of course, varying status in any hierarchical framework and workers in this field have to recognise them. Hitherto boundaries have been characterized by a globally recognizable, extra-ordinary change in the composition of the biota within one or several ecological realms. This approach is still of paramout importance in the Phanerozoic Eon but in the Archaean and Proterozoic Eons a different approach is currently taken. In these older rocks (which include many sedimentary facies) the absence of fossils encourages the use of geochronometry as a means of correlation and boundaries are currently being proposed based on dates in millions of years. These dates are not arbitrarily selected but are placed at (or near) major natural events in the historical geology of the times. It can be claimed, therefore, with varying degrees of certainty and conviction, that all the boundaries in the new **IUGS Global Stratigraphic Time Scale** are natural boundaries with the admitted proviso that all human decisions have an inbuilt fallibility and no ex cathedra pronouncements can be accepted in any field of science.

All stratigraphic decisions are quite inherently based on evidence from and in the rocks and the main stratigraphic speculation, abstractions and hypotheses should be based on rocks — the real concrete factual basis. Historical geology depends on positional relationships of rock and mineral bodies and identification of earth's evolutionary trends. Even in the Phanerozoic Eon other methods than biostratigraphy are now coming forward as an alternative method of defining natural boundaries – magnetostratigraphy and stable isotope peak distributions (carbon, oxygen etc.). Is stratigraphy becoming accepted as including all aspects – biological, physical and chemical. The special value of the boundary stratotype is its definition by a real fixed point in rock in a specific sequence of rock strata in a unique and specific geographical location. A Global Boundary Stratotype Section and Point (GSSP) defines without doubt an instant of geological time. It enables geologists to be sure that at one place by definition time and rock coincide at a boundary between subdivisions of the Global Stratigraphic Time Scale of I.U.G.S. The GSSP is selected on the basis of natural events which are considered to be globally correlatable and synchronous. Global correlation is essential although it is probably never perfect and must be constantly re-examined and improved. These last propositions are examined in detail for selected examples.

II-1-9

Proterozoic mobile belts of the Gondwana Supercontinent (IGCP 288)

Presiding:

George R. Sadowki and Raphael Unrug

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Using post-orogenic granites to recognize Proterozoic inter-continental sutures

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One of the most important issues in the study of possible Proterozoic "suture zones" is the determination of whether they have formed: 1) by collision of formerly separate continental blocks resulting from destruction of intervening oceanic lithosphere; or 2) by large-scale faulting within a previously coherent continental block. The distinction clearly is essential in reconstruction of former continental configurations, such as Pangea at different times in the past. Post-orogenic granites in the proposed suture zone may be just as valid indicators of continental collision as preserved remnants of oceanic lithosphere (e.g., ophiolites).

In order to use post-orogenic granites as a tectonic index, they must be distinguished from anorogenic suites that form within continental crust at considerable time after cratonic stabilization. Anorogenic granites include those associated with anorthosite suites and the granites of alkaline ring complexes. Granites in these categories have compositions that require their derivation by partial melting of old, sialic continental crust. Post-orogenic granites, however, commonly do not occur in association with any other magmatic rocks, form isolated diapirs cutting continental crust only a few tens of millions of years (perhaps less) older than the granites, and have compositional properties (including relatively non-radiogenic isotope ratios) consistent with derivation from basaltic andesites underplated to the crust during subduction of oceanic lithosphere.

Post-orogenic granites are abundant in Phanerozoic collision zones but more scarce in older granulite belts. This distribution could be explained as the result of continental closure at depth in an orogenic belt, with granites, plus ophiolites and supracrustal materials, shoved to high levels and removed by erosion. This explanation is inadequate for two reasons: 1) post-orogenic granites occur in some granulite terrains, where their relatively non-radiogenic isotope ratios distinguish them from the products of local anatexis; and 2) post-orogenic granites are absent from terrains where major intra-continental thrusting exposes rocks of amphibolite grade (or less) on both sides of the thrust zone. Furthermore, post-orogenic magmas derived from crustal underplates should leave some record of their passage upward through lower crust. Apparently, the presence or absence of post-orogenic granites is a significant index of consumption or non-consumption of oceanic crust regardless of the level of exposure in the orogenic belt.

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PROTEROZOIC FOLD BELTS OF SOUTHERN SOUTH AMERICA

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The Proterozoic fold belts of this region are in general poorly exposed due to the extensive Phanerozoic cover and are obliterated by the Cenozoic Andean deformation. However their extension and development are crucial for the understanding of the Late Precambrian evolution of Western Gondwanaland.

They can be subdivided in four different groups, the Early Proterozoic belts (2.1-1.7 Ga), the Grenvillan belts (1.2-1.0 Ga), the Brasiliano belts (0.9-0.57 Ga), and the Pampeano belts (0.60-0.53 Ga).

The Early Proterozoic belts are better represented in the Río de La Plata Craton and they subdivide this craton with N70°W trends in three different terranes: the Charrúa, Uruguay and Tandil terranes. The first two have been amalgamated prior to 2.1 Ga while the third docked at 1.8 Ga.

The belts of Grenvillan age are poorly documented in Western Sierras Pampeanas, in the basement of the Paleozoic Chilenia terrane, and in the Malvinas Plateau terrane. Their structural trends and timing of deformation are poorly constrained, being the main phase of metamorphism bracketed between 1.2 and 1.0 Ga.

The Brasiliano fold belts are better represented. They have a north-south trend, in cases somewhat parallel to the Andean trend. The best known is the Eastern Sierras Pampeanas trend which is represented by a magmatic belt, ultramafics closely associated to tectonites, regional metamorphism and uplift. This resulted in a postcollisional peripheral foreland basin preserved under thick sedimentary sequences of the Chaco Paraná Phanerozoic basin. The main time of deformation is about 560 Ma. Another Brasiliano belt corresponds to the southern extension of Dom Feliciano Belt of Brazil in Uruguay, known also as the Lavalleja belt, and possibly correlates to the Punta Mogotes Schists along the coastal area of Mar del Plata, in Buenos Aires province. The Somuncura belt has a unique N45°W trend along the northern margin of the Patagonia terrane. Scarce data indicate an age for the metamorphic rocks between 850 and 600 Ma.

The Pampean foldbelt corresponds to the Puncoviscana belt of Northwestern Argentina. This belt is composed by sedimentary and metasedimentary rocks bearing Vendian and Early Cambrian faunas, that have been metamorphosed and intruded by intrusive rocks prior to 530 Ma. This is the age of amalgamation and final assemblage of Western Gondwanaland at these latitudes and therefore it constrains any possible amalgamation between Laurentia and Western Gondwanaland in Early Paleozoic times.

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The Middle Proterozoic of South America

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The most outstanding characteristic of the Mesoproterozoic of South America was the formation of large continental masses as result of the coalescence processes worked out by the Trans Amazonian Orogeny, c.a. 1.9/1.8Ga. These supercontinents of millions of square kilometers presented a rigid and coherent behavior posing a complete scenery for intraplate tectonic activities which have lasted at least 1.0 Ga, thus including different sedimentary basins, syneclises, passive and active rifts, etc. associated to many events of plutonism and volcanism of anorogenic character.

In the Amazonian region (craton) and in the eastern central part of Brazil (S.Francisco craton), as pre-Brasiliano domains, the major fragments of those mesoproterozoic supercontinents may be better observed, presenting one of the best representation of the world for intraplate activities, being a difficult task to state chronostratigraphic limits to them.

The fold belts played a secondary role in the Middle Proterozoic evolution of South America, if it is taking in account the existing unaffected records. These remnants may scarcely be found out in the interior of the larger mesoproterozoic masses of Amazonia and S.Francisco.

In fact, the global processes of the Late Proterozoic were widely extended – Brasiliano Cycle – in all Western Gondwana. Their events of fission (diachronic from point to point) and multicollisional fusion (Late Proterozoic up to the Ordovician period) have deeply reworked most of the Middle Proterozoic fold belts, cratonic covers and even older geologic segments. In these conditions, only some Middle Proterozoic fold belts may be recognized, with intracratonic position, and displaying structural trends perpendicular to the Brasiliano collisional fronts. These were indeed the sine qua non conditions to be preserved as geological entities up to Phanerozoic times.

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Tectonic Evolution of the Joinville Massif, Southern Brazil.

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The Joinville Massif (JM) is composed of medium to high grade metamorphic rocks that separate the major orogenic belts of southern Brazil – The Dom Feliciano Belt (DBF) in the south and the Ribeira Belt (R) in the north. Since its recognition it has been understood as a rigid and coherent block between these two Belts.

Recent data demonstred that its internal large-scale structure includes three different units that assembled only in Late Proterozoic after the major metamorphic and magmatic events in the surrounding DFB and R belts.

The southern JM domain represents a microplate dominated by hyperstene quartz feldspar granulites understhrust against the northern domain which is composed of medium grade amphibole banded gneisses. In the southern domain radiometric ages ranging from Archean to Early Proterozoic were obtained in a clear contrast, when compared with the northern part, were Late Proterozoic ages are predominating related to a regional overprint migmatization process. The zone between these two domains is marked by a suture representing a Late Proterozoic deformed volcanic arc granitoids and several slices of mafic to ultramafic bodies thrusted over the granulitic rocks of the southern domain.

The Eastern side of the JM is formed of the youngest unit, the Paranagua Batholith which includes medium to coarse amphibole biotite granitoids to late two mica leococratic granitoids. Its geochronological ages are restricted to 560±60Ma.

The Joinville Massif is interpreted as three accreted terranes, always with a predominantly NW accretion direction associated to the Brasiliano orogenic collage processes that occured in the Latest Proterozoic and Earliest Paleozoic time.