LATE PALEOZOIC - EARLY MESOZOIC PLUTONISM AND RELATED RIFTING IN THE EASTERN CORDILLERA OF PERU

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INTRODUCTION

Continental and marine sedimentary rocks of Permian, Triassic and Jurassic age have long been reported from central Peru (McLaughlin, 1924; Steinmann, 1929). These rocks traditionally form the Mitu and Pucará groups (Harrison, 1943, 1951; Jenks, 1951; Newell et al., 1953) and crop out nearly all along the Eastern Cordillera of Peru (Dalmayrac et al., 1980). The Mitu group furthermore includes volcanic rocks that are related to coeval granitoid emplacement, and records rifting processes of Late Permian-Triassic age (Mégard, 1978; Noble et al., 1978; Dalmayrac et al., 1980; Kontak et al., 1990; Rosas et al., 1997; Sempere et al., 1998).

Rifting initially produced grabens where locally >2000m-thick alluvial and lacustrine red deposits and evaporites accumulated above preserved Upper Paleozoic strata. Paleoenvironments include alluvial fans, streams, and (playa-)lakes. Limestones bearing Late Permian fusulinids are locally intercalated in the alluvial infill and record marine ingressions within some grabens (Laubacher, 1978). Abundant alkaline volcanic rocks were locally erupted in relation with plutonism at depth (Noble et al., 1978, Kontak et al., 1990).

In northern and central Peru, subsequent thermal sag permitted that the sea ingressed from the north along the rift axis (Fig. 1). The Pucará Group carbonates were deposited during the Norian-Liassic interval (Rosas and Fontboté, 1995). Numerous manifestations of basic alkaline volcanism are reported from the western Pucará basin (Kobe, 1995). In the eastern and southeastern Peru, time-equivalents deposits of the Pucará Group are in part represented by continental red beds (lower Sarayaquillo Fm; Mégard, 1978).

In southern Peru (Arequipa area), extension progressed during the Liassic and Dogger, and culminated in the Bajocian-Bathonian when a deep marine trough formed (Yura Group, Vicente et al., 1982; Sempere et al., 1999). West of Lake Titicaca, synsedimentary extension is recorded, and basic sills intrude the Paleozoic and the Jurassic Muni Fm; the latter is transitionally overlain by the Lower Huancané Fm fluvio-eolian sandstones (Newell, 1949), which recalls the basalt-bearing Ravelo Fm of Bolivia. Fluvio-eolian sandstones occur in the Caycay Fm of the Cusco-Sicuani area, locally associated with alkaline basalts (Carlotto, 1998).

The roots of this late Paleozoic-early Mesozoic rift are exposed in the Eastern Cordillera and are mainly composed of Precambrian to early Paleozoic metamorphic rocks (Sempere et al., 1999). In central Peru, peridotite bodies occur in Precambrian metamorphic rocks, Mississippian plutons and at the Mitu/Pucará contact (Aumaître et al., 1977; Jacay, 1996; Mégard et al., 1996; Quispesivana, 1996). Given these geologic relationships, the peridotite bodies were possibly emplaced in the Jurassic in relation with major stretching and/or wrenching of the crust and with basic magmatism in this segment of the rift system. It is possible that in this segment rifting reached a state significantly more advanced than in other areas due to its earlier onset.

Numerous plutons also intrude the metamorphic basement exposed in the rift roots. They consist of a variety of granites, granodiorites and alkaline granitoids, which apparently display 2 clusters of ages: a large set of mainly northern plutons was emplaced during the Mississippian, and a larger one during the Late Permian and Triassic (Table 1; Fig. 1). This suggests that Late Permian-Triassic rifting was established along an area that had already been weak in the Mississippian.

Table 1: Ages obtained on Late Paleozoic - Early Mesozoic plutons in the Eastern Cordillera of Peru.

age (Ma)	method	dated	locality	composition	reference
359 ± 14	K/Ar	wr			Bonhomme et al., 1985
346.7 ± 7.3	K/Ar	B	Balsas	monzogranite to syenogranite	Sánchez, 1983
346 ± 10	K/Ar	B	Pacococha	adamellite	Maluski & Blatrix *in* Mégard, 1978
338 ± 8	K/Ar	B	Callangate-Enaben	granodiorite to monzogranite	Sánchez, 1995
331 ± 5	K/Ar	H		monzodiorite	Bonhomme et al., 1985
331 ± 20	K/Ar		Tambo-Perené	basalt	Martin & Paredes, 1977
330 ± 10	U/Pb	Z	Amparaes	orthogneiss	Lancelot *in* Marocco, 1978
329 ± 1	U/Pb	Z	Parcoy	granodiorite	Vidal et al., 1995
329 ± 10	K/Ar	B	Callangate-Enaben	granodiorite to monzogranite	Sánchez, 1995
321	Ar/Ar	B	Pataz	granodiorite to monzogranite	Schreiber et al., 1990
305	Ar/Ar	H	Pataz	granodiorite to monzogranite	Schreiber et al., 1990
294 ± 3	K/Ar	H	C° Pucará	essexite	Bonhomme et al., 1985
279.9 ± 3.3	K/Ar	wr	16°40'S, 68°36'W	basalt	Kontak et al., 1990
272 ± 10	K/Ar	H + B	C° Pucará, Juliaca	lava	Klinck et al., 1991
270	K/Ar	B	San Judas Tadeo	monzogranite	Kontak et al., 1985
262.9 ± 4.5	K/Ar	B	San Judas Tadeo	granodiorite	Kontak et al., 1985
260 ± 25	K/Ar	wr	hacienda Chorrillos	diorite	Rocha-Campos & Amaral, 1971
257 ± 3	U/Pb	Z	Quillabamba	granite	Lancelot et al., 1978
253 ± 11	K/Ar	M	Esquicocha	granite	Soler et al., 1990
251	K/Ar		Villa Azul	granite	Stewart et al., 1974
246 ± 10	Rb/Sr	B	Machu Picchu	granite	Priem *in* Egeler & De Booy, 1961
245 ± 11	K/Ar	B	Talhuis	quartz-diorite to granodiorite	Soler et al., 1990
244.9 ± 2.9	K/Ar	glass	16°40'S, 68°36'W	basalt	Kontak et al., 1990
238 ± 11	U/Pb	Z	Coasa	granite	Lancelot et al., 1978
238 ± 10	Rb/Sr	wr	La Merced	granite	Capdevila et al., 1977
236 ± 6	K/Ar	B	Huisaroque	tonalite	Klinck et al., 1991
235 ± 3	U/Pb	Z	Aricoma	granodiorite	Lancelot *in* Carlier et al., 1982
233 ± 10	K/Ar	B	Carrizal	tonalite / quartz-monzonite	Soler et al., 1987

230 ± 10	U/Pb	Z	Ancoma	granodiorite	Lancelot *in* Laubacher, 1978
227 ± 3	K/Ar	H		essexite	Bonhomme et al., 1985
225 ± 14.8	K/Ar	M	Ancoma	quartz vein	Kontak et al., 1990
222 ± 7	U/Pb	Z	Abancay	cataclastic ?granite	Lancelot *in* Carlier et al., 1982
216.8 ± 4.5	K/Ar	B	Aricoma	monzogranite	Kontak et al., 1990
216.2 ± 4.3	K/Ar	M	Coasa	granite	Kontak et al., 1990
211.0 ± 10.1	Rb/Sr	wr + B	Coasa	monzogranite	Kontak et al., 1990
210.9 ± 4.3	K/Ar	B	Coasa	monzogranite	Kontak et al., 1990
210.8 ± 4.2	K/Ar	B	Coasa	monzogranite	Kontak et al., 1990
210.7 ± 10.4	Rb/Sr	wr + B	Aricoma	monzogranite	Kontak et al., 1990
210.2 ± 4.2	K/Ar	B	Coasa	monzogranite	Kontak et al., 1990
209.3 ± 4.2	K/Ar	B	Coasa	monzogranite	Kontak et al., 1990
208.5 ± 2.6	Rb/Sr	wr + B	Coasa	monzogranite	Kontak et al., 1990
207.8 ± 4.4	K/Ar	B	Coasa	monzogranite	Kontak et al., 1990
207.7 ± 4.1	K/Ar	B	Coasa	monzogranite	Kontak et al., 1990
205.6 ± 10.3	Rb/Sr	wr + B	Coasa	monzogranite	Kontak et al., 1990
205.3 ± 4.2	K/Ar	B	Coasa	monzogranite	Kontak et al., 1990
204.5 ± 6.4	Rb/Sr	wr + B	Coasa	monzogranite	Kontak et al., 1990
204.1 ± 1.5	Rb/Sr	wr + B	Coasa	monzogranite	Kontak et al., 1990
202 ± 2	U/Pb	Z	San Gabán	gabbro to diorite and monzogranite	Kontak et al., 1991
199 ± 10	Rb/Sr	M	Limacpampa	monzogranite	Kontak et al., 1990
180	K/Ar	B	Macusani	syenite	Stewart et al., 1974
174.7 ± 3.6	K/Ar	B	Allinccápac	syenite	Kontak et al., 1990
173.5 ± 3.1	K/Ar		Macusani	syenite	Kontak et al., 1985
133 ± 7	Rb/Sr	M	Gavilán de Oro	granite	Kontak et al., 1990
131 ± 5	K/Ar		Ayacucho	lava	Noble et al., 1978

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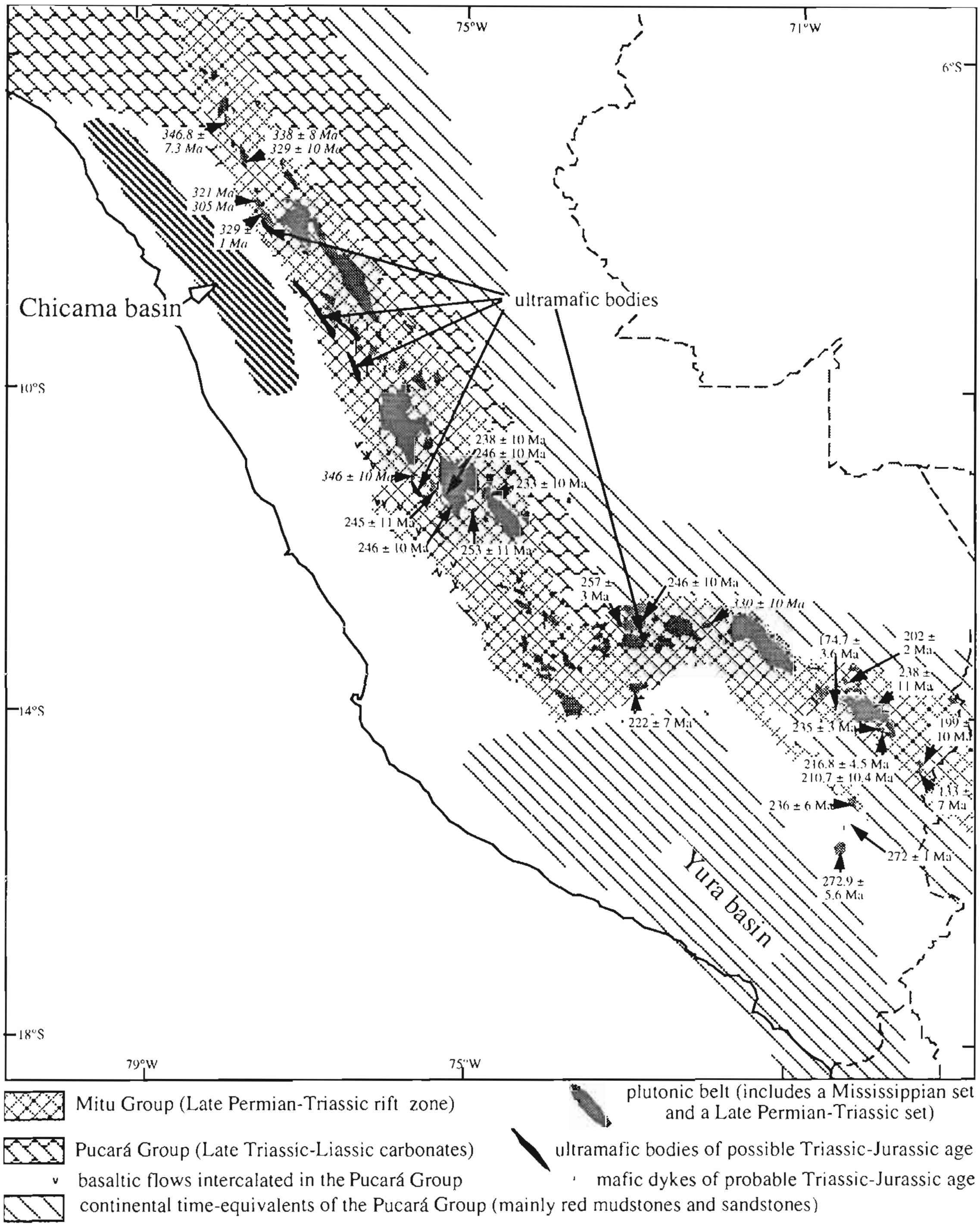

Figure 1. Selected Upper Paleozoic - Jurassic paleogeographic elements of Peru.