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EDADES K-Ar DE ROCAS HERCINICAS Y NEOGENAS DE UN PERFIL E-W EN EL PERU MERIDIONAL

K-Ar AGES OF HERCYNIAN AND NEOGENE ROCKS ALONG AN EAST WEST CROSS SECTION IN SOUTHERN PERU

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Cartographic surveys along the parallel 14°S, in the Eastern Cordillera, and on the Altiplano, lead to a synthetic cross-section wich will be used as a reference (AUDEBAUD et al, 1976). The new data was collected from two synthetic studies (CARLIER et al, 1982; KONTAK et al, 1983) of this region, where the Paleozoic and frequently azoic formations prevail, and where the polyphased tectonics, sometimes localized along deformation channels make correlations difficult.

Conventional K-Ar age determinations (Table 1) have been performed on various formations along this profile. The analytical process (LAVENU et al., this volume) has been applied to whole rocks and various purified mineral fractions.

RESULTS AND DISCUSSION

1. Age reliability from isotopic data

For the Hercynian samples of the Eastern Cordillera, the mineral fractions yield discordant results. The amphiboles show ages from 372 to 294 Ma, the biotites from 105 to 87 Ma, while the two plagioclases 70K7 and 70-158 have apparent ages of 800 and 500 Ma, respectively. These values are geologically impossible. They may be explained by the effects of the thermal episode of the Upper Cretaceous, confirmed by the ages of the biotites, and wich releases a part or the totality of the radiogenic argon from the potassic minerals. The plagioclases salvage this argon, available in the metamorphic fluid. Thus, their apparent age is only the consequence of an excess of argon.

In these conditions, the only reliable results are the following:

- The age of the biotites, or that calculated from the plagioclase-biotite pairs, that is 80 to 60 Ma, represents the oldest age possible for the thermo-tectonic episode regarded as Cretaceous.
- The age of the amphiboles, the blocking temperature of wich seems to have been reached only locally, (samp. 70-159), dates the Hercynian metamorphism, which reached up to the sillimanite isograd.
- The "age" of the whole rocks, being the result of a mixture of the respective "ages" of the constituing minerals, whose responses to the Cretaceous event are variable, have no chronological meaning.

For the samples of Neogene age (younger than 30 Ma), the same process occurs, on a smaller scale. For instance, the amphibole and the biotite EA 84 show ages of 28 Ma, whereas the K-Feldspar age is slightly younger at 26 Ma and that the whole

TABLE 1

UBICACION, PETROGRAFIA Y DATOS ISOTOPICOS K-Ar DE LAS MUESTRAS ESTUDIADAS

LOCATION, PETROGRAPHIC AND K-Ar ISOTOPIC DATA OF THE STUDIED SAMPLES

Sample number	Petrographic type	Longitude	Latitude	Analysed fraction	K_2O %	$^{40}Ar_{rad}$ %	$^{40}Ar_{rad}$ (nl/g)	t(Ma ± 1σ)
EO – and LATE HERCYNIAN EVENTS in the EASTERN CORDILLERA								
70-155	biotite amphibolitic gneiss	70°55 W	13°20S	WR	0.633	88.0	7.92	359.0 ± 14.0
				H	0.540	84.1	6.55	372 ± 7
				B 1	8.08	90.3	22.8	87.0 ± 1.3
				B 2	4.94	93.5	16.11	100.9 ± 1.8
70-158	essexite	70°54 W	13°26S	H	1.300	92.3	12.42	294 ± 3
				P 1	0.635	82.2	11.00	529 ± 12
				B	8.54	95.2	29.1	105.2 ± 1.3
70-159	essexite	70°54 W	13°26S	H	1.328	92.8	9.79	227 ± 3
				B	8.73	94.6	37.7	133.3 ± 1.2
70 K 7	monzodiorite	70°54W	13°28S	H	1.860	95.3	20.06	331 ± 5
				P1	0.448	80.4	14.87	814 ± 13
				B	9.28	93.0	26.8	89.3 ± 1.4
WHOLE ROCK AGES: "HERCYNIAN" AGES WITH ANDEAN RESETTING)								
EA 37	granodior.	70°16W	14°19S	WR	3.39	88.6	18.94	169 ± 7
Nu 83	phonoteph.	70°35W	14°10S	WR	5.47	80.4	20.60	116 ± 5
Nu 98a	monzodior	70°40W	14°15S	WR	6.34	78.0	10.37	61 ± 2
Nu 99	micro-monzodior.	70°40W	14°15S	WR	5.41	78.5	16.63	95 ± 4
EA151c	granite	71°00W	14°29S	WR	5.16	88.5	20.17	120 ± 6
ANDEAN EVENTS: 1) EASTERN CORDILLERA								
Nu152	ignimbrite flow	70° 40°W	13°50S	KF	11.52	87.4	13.25	35.6 ± 0.6
Nu93	quartz-fatile dyke	70°35W	14°20S	WR	6.22	77.1	4.50	22.3 ± 0.6
Nu168	rhyol. ignim.	70°30W	14°18S	B	8.63	80.0	7.09	25.3 ± 0.5
70C5	stibnite ignim. dyke	70°55W	13°40S	KF	11.71	77.6	7.70	20.3 ± 0.5
				B	8.46	62.5	5.22	19.1 ± 0.4
Nu126	tourmaline	70°50W	14°10S	WR	4.93	76.4	3.83	23.9 ± 0.8
70-167	lamprophyre dyke	70°45S	14°45S	B	9.23	12.15	0.634	2.1 ± 0.3
Nu307	gabbro intrusion	70°45W	13°15S	WR	2.84	46.1	2.34	26.0 ± 1.0
ANDEAN EVENTS: 2) ALTIPLANO								
EA96c	taphrite flow	70°37W	15°00S	WR	1.992	48.8	1.490	23.6 ± 0.9
EA96d	phonolitic tephr. flow	70°37W	15°00S	WR	5.27	68.7	4.51	26.9 ± 1.0
				KF	10.64	86.3	10.08	29.3 ± 0.6
EA99	porphyric trach. flow	70°36W	14°56S	WR	8.71	89.5	7.82	28.3 ± 1.0
EA31	shoshonite flow	70°33W	15°14S	WR	2.27	48.7	1.744	24.3 ± 1.0
EA74	bas. andesite dyke	70°24W	15°06S	WR	2.29	43.0	1.122	15.1 ± 2.0
EA84	monzogab. intrusion	70°31W	15°04S	WR	3.14	52.4	2.81	23.5 ± 0.9
				H	2.49	67.5	2.27	26.2 ± 1.5
				KF	11.68	77.5	9.86	26.1 ± 0.7
				B	8.42	83.1	7.56	27.8 ± 0.6
EA88	monzogab. intrusion	70°29W	15°05S	WR	3.70	89 0	3.30	28.1 ± 1.0
				P 1	4.58	69.2	4.20	28.4 ± 0.5
				KF	8.40	60.3	7.84	28.7 ± 1.5
EA114	quartz monzon zon. intr.	71°30W	14°03S	WR	4.49	81.0	5.22	37.0 ± 1.5
EA85	granite intrusion	70°31W	15°05S	WR	3.91	29.4	2.72	22.0 ± 0.9
				KF	9.49	44.3	7.09	23.1 ± 1.1
				B	8.10	68.0	4.96	19.0 ± 1.1
EA89	ignimbritic rhyol.	70°31W	15°08S	WR	6.53	61.5	2.64	14.7 ± 0.7
				KF	9.72	81.2	5.65	18.0 ± 0.6
				P 1	1.134	47.5	0.596	16.3 ± 0 9*
				B	8.17	53.5	4.46	16.9 ± 1.1

(1) analysed fractions. WR - Whole rock, H- amphibole, Pl plagioclase, KF K - feldspar, B-biotite.

(1) fracciones analizadas: WR-roca total, H-anfibola, pl- plagio clasa; KF feldespato potásico; B-biolita.

rock age is lowered by nearly 15°/o to 23.5 Ma. This may be related to the tectonic event Quechua 1, which alters the feldspar more than the biotites and the amphiboles Only the ages of the latter have been taken into account, those of the other fractions beeing regarded as more doubtful.

Three groups of ages may thus be considered:

- at least 35 Ma for Nu 152 and EA 114
- nearly 28-25 Ma for Nu 168, Nu 307, EA 96, EA 84 and EA 88;
- nearly 20 Ma for 70 C5, EA 85 and EA 89,
- the other samples being dated with less certainty.

Finally, the lamprophyre 70-167 shows an age nearly identical to that of the Chijini tuff in Bolivia (LAVENU et al. this volume).

2. Stratigraphic and tectonic consequences

– Eohercynian to Permotriassic ages in the Eastern Cordillera.

Between Marcapata and Quincemil, a series of orthogneisses, quarzites, amphibolites and rare cipolins, which lie in cartographic unconformity under Ordovician formations, cannot be regarded as initially Paleozoic. But the geological contacts, hidden by numerous synto post-metamorphic intrusives, a strong mylonitisation of the eastern Eastern Cordillera, no longer permits us to consider them as definitely Precambrian, as previously thought. In fact, the Paleozoic at Marcapata, is certainly affected by a low pressure metamorphism up to andalusite, and the underlying basement is polymetamorphic.

The K-Ar age of the amphiboles confirms the age of the intense metamorphism at 370 Ma, but the question of the nature of the initial material still, whether it is metamorphic Precambrian or Paleozoic (the associated orthogneisses have shown U-Pb ages of 330 Ma) remains open.

The Permian consists of a molassic detrital series and of volcanics, followed by granitic intrusions, related to an aborted rift (VIVIER et al., 1976; KONTAK et al., 1985). The new data set with ages as old as 330 Ma; the intrusion at Marcapata of a batholith of fresh essexites and monzodiorites representing the alkaline undersaturated magmas, complete the data by Kontak et al. (1985) and Carlier et al. (1982), in documenting two episodes of mantellic material injection in the eastern Eastern Cordillera.

– Neogene ages.

Within the Paleozoic formations of the Eastern Cordillera, ignimbritic, sometimes lamprophyric dykes were until present regarded as related to the ignimbritic emissions dated around Macusani at 4.5 Ma. The tectonic deformation shown by these dykes indicate that they might be older. This is confirmed by the present dates of 25 to 20 Ma. These ages are comparable to those obtained by KONTAK et al. (1985) towards the SE. The lamprophyre dated back at 2.1 Ma demostrates the extent of the very young extrusions like in Bolivia and at Macusani. Thus, the magmatic activity goes on during the Miocene in the Eastern Cordillera, that is, during the Quechua 1 tectonic phase and the important erosional episode which forms the Puna.

At the Western Cordillera-Altiplano, where the Cenozoic sedimentation is well developped, a deformation episode can be dated precisely between 23-22 Ma (EA 85 granites, posterior to the monzogabbro and associated flow), and 18-15 Ma (rhyolite EA 89). This also demonstrates the wide extension of the Quechua 1 event on the whole width of the Andes. The deposition of olistoliths of Cretaceous formations in the Tertiary may thus be situated within the Miocene (West of Langui Lake).

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