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EDADES RADIOMETRICAS PRELIMINARES DE PENINSULA MEJILLONES, NORTE DE CHILE

PRELIMINARY RADIOMETRIC AGES FROM THE MEJILLONES, PENINSULA, NORTHERN CHILE

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The Mejillones Peninsula lies inmediately NNW of Antofagasta, between latitudes 29°31' and 23°32'S. It is 56 km long, has an average width of 10 km, and is composed mainly of plutonic and metamorphic rocks affected by different phases of deformation, metamorphism and metasomatism. This association was included in the Jorgino and Bolfim Formations by Ferraris and Di Biase (1978). Recently the geology of Mejillones Peninsula was re-examined by Venegas (1979), Baeza (1984) and Baeza and Venegas (1985). According to these authors, three regiones of different lithologies are distinguished in the crystalline basement (Fig.1):

The Northern Region is formed by the series of schist-quartzite-amphibolite of Punta Angamos-Caleta Herradura, intruded by the Morro Mejillones Tonalite and the San Luciano Gabbro. The tonalite pluton has developed a thermal aureole within the metamorphics, superimposed to a low grade regional metamorphism (Baeza and Venegas, 1985). The contact aureole developed concentric biotite, andalusite and sillimanite zones.

The Central Region is formed by the Caleta Bandurrias-Cerro Jorgino, metamorphic association in which biotite-garnet gneisses occur interbedded with green brown hornblende amphibolites. These rocks were affected by an intermediate pressure Barrovian type regional metamorphism, with the development of biotite, garnet and kyanite metamorphic zones (Baeza, 1984).These rocks were intruded by frequent and mainly leucotonalite veins.

The Southern Region consists of a mafic to ultramafic plutonic complex formed principally by hornblende gabbros. They include pyroxenite bodies in the southern part and they are affected by cataclastic deformation, as well as deuteric and hydrothermal alteration, but not regional metamorphism.

GEOCHRONOLOGY

Fig. 1 presents the location of the samples and figures 2, 3, 4 exhibit the Rb-Sr interpretations for the northern, central and southern regions respectively. Results by the K-Ar method are presented in Table 1, and Rb-Sr data on Table 2.

Sample MD-3 is a fine grained aplite associated to the Morro Mejillones tonalite and probably related to the terminal activity of this plutonic complex. If we take into account a previous whole rock Rb-Sr determination by Halpern (1978), at outcrop H-73-27 from the same tonalitic body, a probable age of 200 Ma with an inicial Sr^{87}/Sr^{86} ratio of 0.7043 can be attributed to the final events related to the Morro Mejillones intrusive

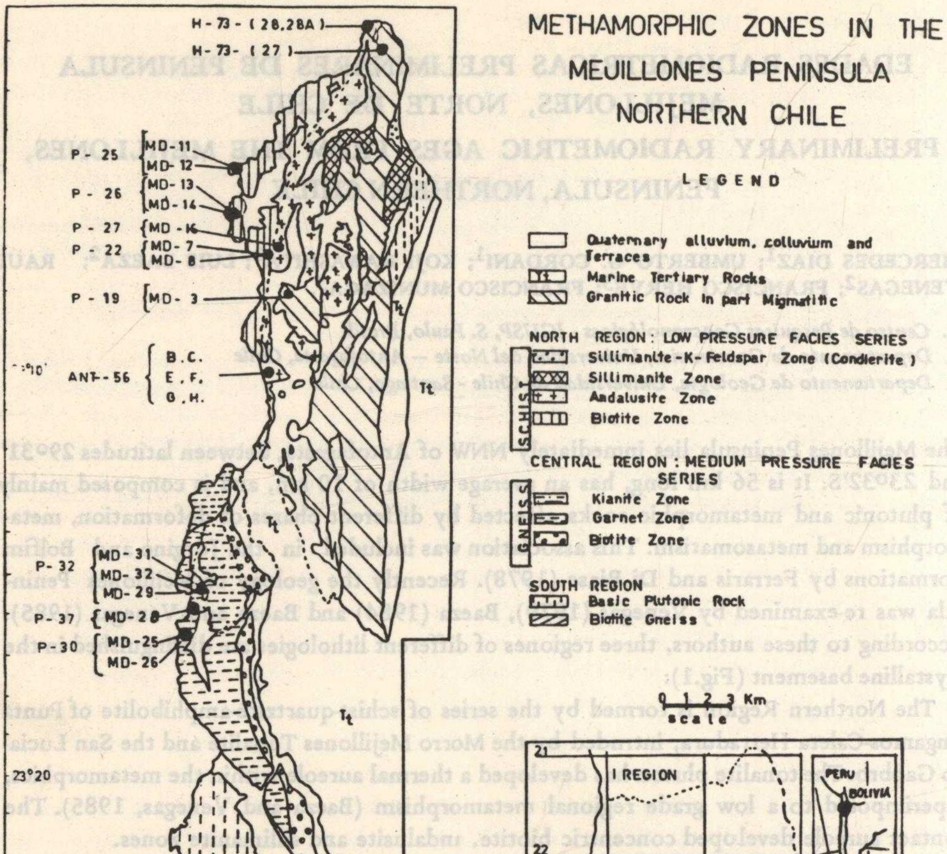

Fig.1. Geologic map and sample location of Mejillones Peninsula.
Fig.1. Mapa Geológico y de ubicación de muestras de Península de Mejillones.

TABLE 1

DETERMINACIONES K-Ar (CPGEO)
K-Ar DETERMINATIONS (CPGEO)

SAMPLE Nº	ROCK TYPE	MATERIAL	Age(Ma)
MD-58	Gabbro	Amph.	108 ± 7
MD-58	Gabbro	Plag.	116 ± 7
MD-29	Amphibolite	Amph.	167 ± 8
MD-16	Amphibolite	TR	172 ± 12
MD-7	Amphibolite	TR	177 ± 8

TABLE 2

DETERMINACIONES Rb-Sr
DETERMINATIONS Rb-Sr

Outcrop	Sample Nº	Labor Nº	Rock Type	Sample	Rb ppm	Sr ppm	$^{87}Rb/^{86}Sr$	$^{87}Sr/^{86}Sr$
P–19	MD– 3	7862	Aplite	TR	95.5	54.0	5.12	0.7187
P–22	MD– 7	7857	Amphibolite	TR	8.0	331.2	0.07	0.7138
P–22	MD– 8	7858	Mica-Schist	TR	133.8	58.0	6.69	0.7292
P–25	MD–11	7859	Mica-Schist	TR	216.3	193.4	3.24	0.7292
P–25	MD–12	7852	Quartzite	TR	71.4	163.2	1.27	0.7201
P–26	MD–13	7860	Quartzite	TR	71.4	105.5	1.96	0.7242
P–26	MD–14	7861	Schist	TR	165.8	109.9	4.38	0.7323
P–30	MD–25	7866	Gneiss	TR	129.9	180.1	2.09	0.7191
P–30	MD–26	7867	Leuco-tonalite	TR	64.3	165.9	1.12	0.7145
P–31	MD–28	7868	Gneiss	TR	85.5	52.0	4.77	0.7236
P–32	MD–31	7869	Gneiss	TR	51.3	108.2	1.37	0.7142
P–32	MD–32	7870	Leuco-tonalite	TR	83.3	184.1	1.31	0.7142
P–39	MD–44	7855	Leuco-tonalite	TR	69.7	328.5	0.61	0.7055
P–39	MD–45	7856	Diorite	TR	23.0	843.4	0.08	0.7038
P–40	MD–46	7863	Gabbro	TR	88.6	329.7	0.78	0.7058
P–40	MD–47	7864	Gabbro	TR	38.9	272.6	0.41	0.7049
P–40	MD–48	7865	Tonalite	TR	73.7	301.4	0.71	0.7060
P–40	MD–49	7853	Qz–Feld Dyke	TR	168.0	105.7	4.60	0.7171
P–40	MD–50	7854	Pegmatite	FELD	109.3	87.5	3.62	0.7135
P–42	MD–57	7871	Aplite	TR	110.5	82.5	3.88	0.7189
Ant–56 •	B		Micaschist	TR			7.957	0.74398
Ant–56 •	C		Schist	TR			0.770	0.71197
Ant–56 •	E		Schist	TR			1.774	0.71996
Ant–56 •	F		Schist	TR			2.980	0.72827
Ant–56 •	G		Schist	TR			1.052	0.71925
Ant–56 •	H		Amphibolite	TR			0.185	0.70504

TR: whole rock Feld. : Feldspar

• Samples analyzed at BGS, London

complex (See Fig. 2). Slightly younger values were obtained by Damm and Pichowiak (1981) and Berg and Breitkreuz (1983) by Rb-Sr and U-Pb methods, in plutonic rocks located to the south of Antofagasta (Taltal and Chañaral, respectively) but along the same tectonic trends, defining what may be one of the major granite forming events in Northern Chile.

Five different outcrops of the metamorphic rocks of the northern region were dated by the Rb-Sr method. The analysed samples are principally located within the biotite zone, the externalmost one of the contact aureole. They comprise mainly mica-schists, but include some calc-silicate rocks, amphibolites and quartzites. In the metamorphic samples, besides quartz and muscovite, which are ubiquitous, biotite occurs as small crystals and porphyroblasts arranged parallel to the main schistosity. In part, it is altered into chlorite. Garnet, tourmaline and sometimes calcite are accidental minerals. The analytical points plotted in Fig. 2 exhibit great dispersion, indicating that Sr isotopic homogenization was not attained, even for samples from the same outcrop. This is the case, for instance, of the six samples from outcrop ANT-56, which are considerably scattered in the isochron diagram.

Some segments of straigth lines are indicated in Fig. 2, connecting points of samples from the same outcrop. The lines should not be considered as isochrons, nor the apparent age values as geologically significant. However, the general trend is consistent with a regional metamorphism somewhere in the late Palaeozoic, followed by a superimposed thermal event at about 200 Ma which is taken as the age of the tonalitic intrusion. The times of sedimentation, and of earlier episodes of metamorphism, are entirely open to conjectures. The alignement of three of the samples from outcrop ANT-56, which is possibly the least affected by the thermal metamorphism, could be significant, and the apparent age of about 530 Ma may be indicative of an Early Paleozoic metamorphic event. Even a Precambrian age for these rocks cannot be discarded.

The apparent Sr^{87}/Sr^{86} initial ratios of the straight lines, well above 0,71, are consistent with a metasedimentary origin, and with chemical redistribution during a later metamorphism, but without a complete isotopic homogenization.

The analysed samples in the central region are biotite, hornblende and garnet bearing gneisses characterized by small lenticular bands of light and dark minerals, with granoblastic texture and a microfolded schistosity. The analytical points in Fig. 3 exhibit a large dispersion, as for the rocks of the northern region. A similar interpretation can be given, and a reference isochron, strongly influenced by the position of sample MD-28, indicates a tentative age of 190 m.y. A direct comparison of figures2 and 3 also suggest a tendency of the gneissic rocks of the central region to exhibit a smaller radiogenic strontium component than the schists and quartzites of the northern region. This indicates higher initial $^{87}Sr/^{86}Sr$ ratios for the metamorphic isochrons of the northern region, and consequently higher detrital component (or older age) for their protoliths.

Three K-Ar results obtained on amphiboles from the northern and central regions (Table 1, Samples MD-29, MD-16, MD-7) are concordant within experimental error at about 170 Ma., a value which is also consistent with a Rb-Sr biotite age of 160 Ma. indicated by Halpern (1978) for sample H-73-27. These apparent ages could be geologically significant, and may correspond to a generalized regional cooling, or to a definite tectonothermal event occurred in Jurassic times, whose tectonic significance still has to be determined.

The analysed samples from the plutonic complex in the southern region are gabbros and related rocks, including diorites and tonalites. The mineralogy is quite simple, plagioclase and hornblende being predominant. Quartz and biotite are present in the tonalites, and microcline together with quartz makes up the main part of some pegamattic phases, represented by samples MD-49 and MD-50. Sample MD-57 is different from the others, coming from a gneissic aplitic dyke of granodioritic composition.

Figure 4 is an isochron diagram with the analytical results for the southern region. With the exception of sample MD-57, all the others define a well fitted isochron with 200 ± 10 Ma and Sr^{87}/Sr^{86} initial ratio of 0.7034. The isochron includes the two K-feldspar points of the pegmatitic phases MD-49 and MD-50, but also the other more basic

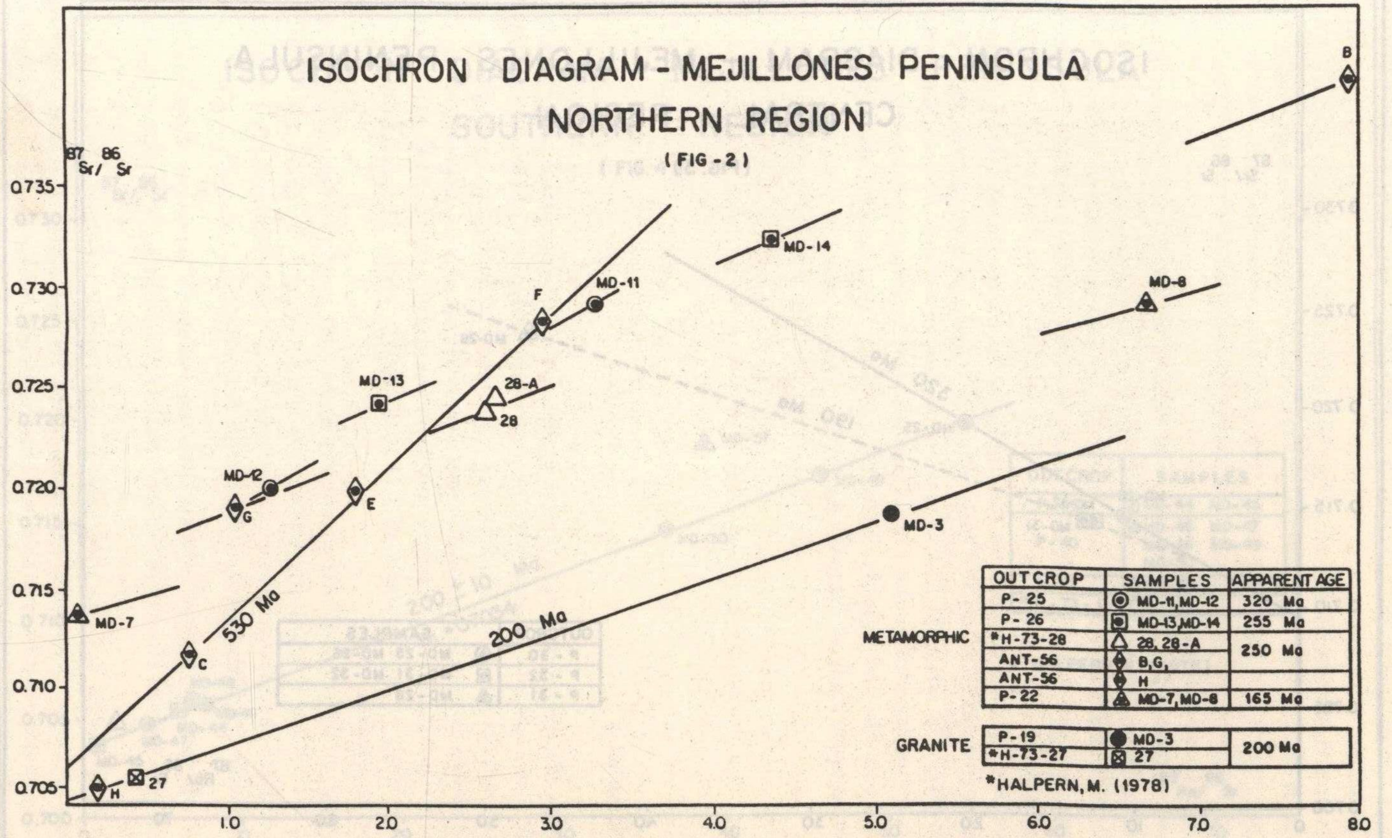

Fig.2. Diagrama isocrónico para la región N de la Península de Mejillones.

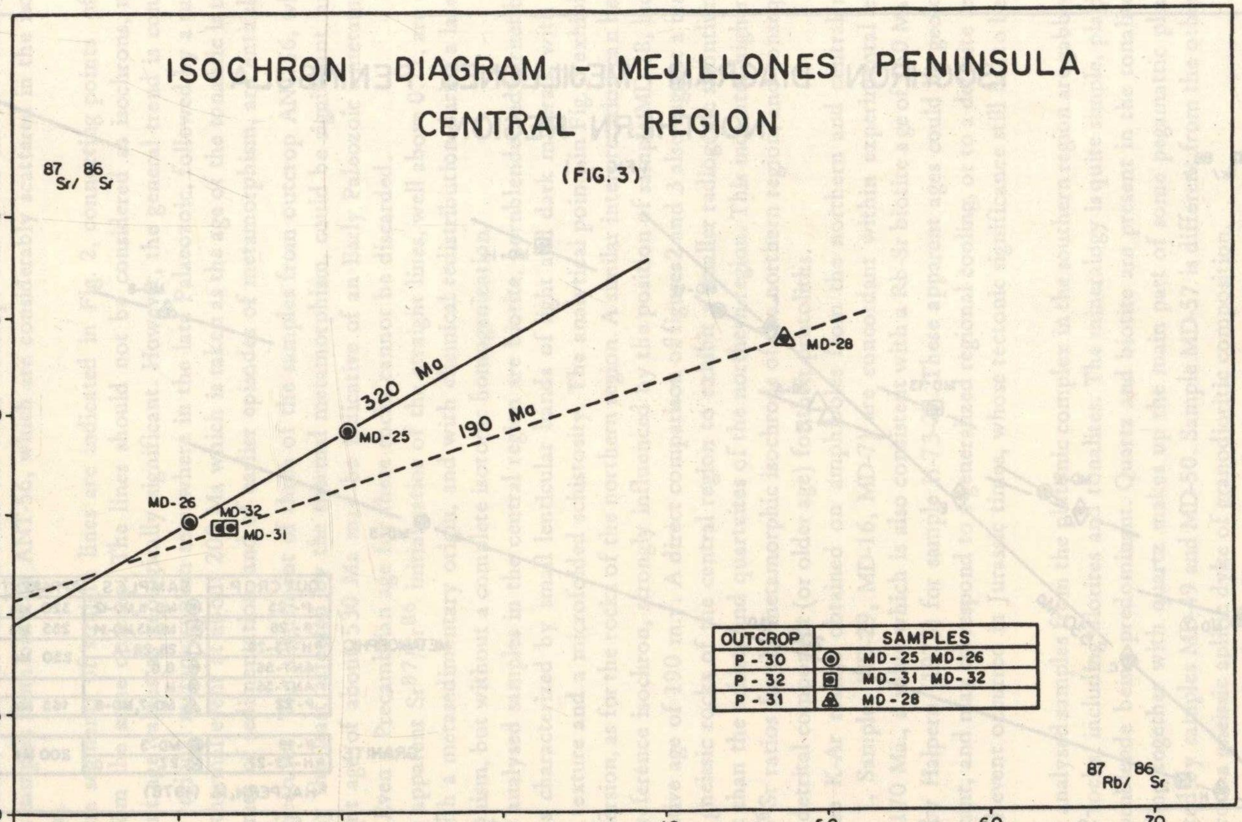

Fig.3. Diagrama isocrónico para la región Central de la Península de Mejillones.

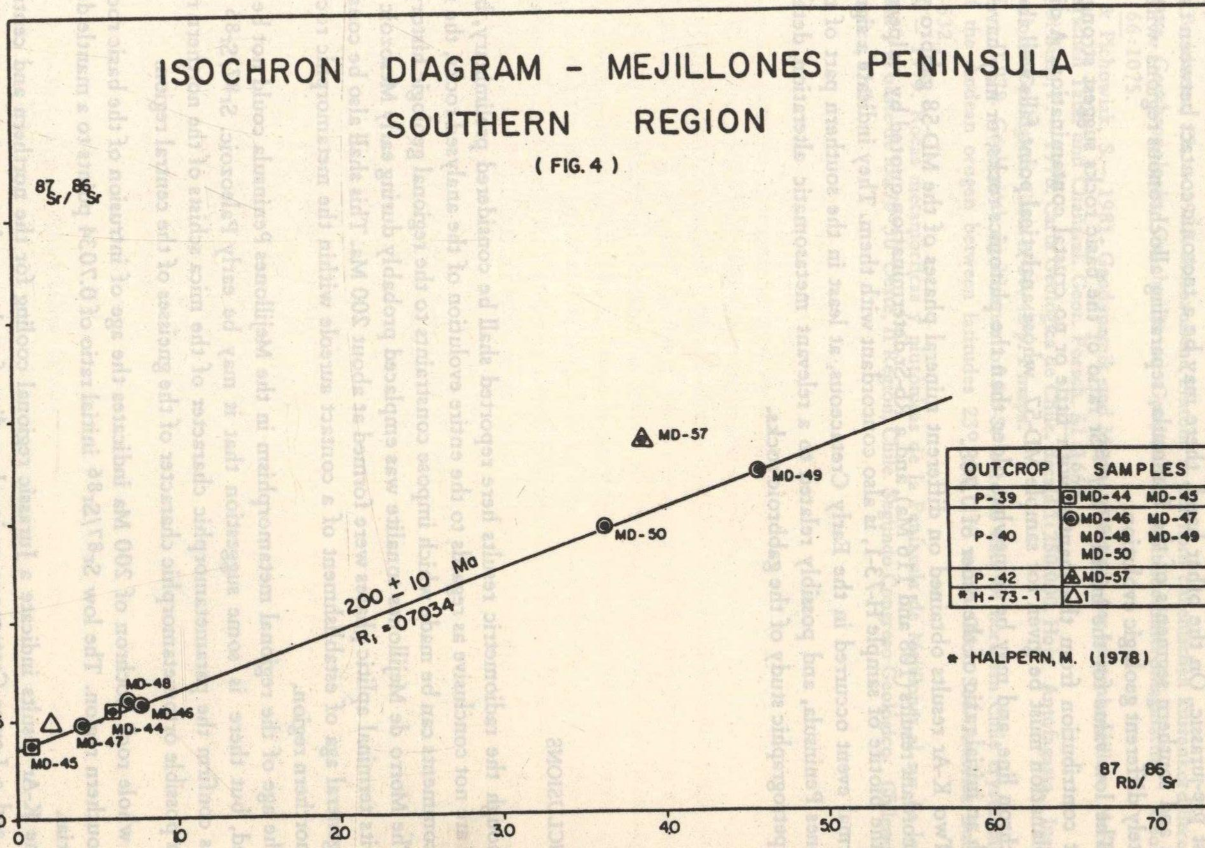

Fig.4. Diagrama isocrónico para la región Sur de la Península de Mejillones.

varieties are colinear. An additional determination by Halpern (1978), Sample H-73-1, on a quartz-diorite form the southern most part of the Morro Moreno was also included in Fig. 4, for comparison. The age value indicates the time of the basic intrusion, in the early Mesozoic.

The fact that the gabbroic rocks are not affected by a regional metamorphism may set a limit for the main metamorphic phase of the Mejillones Peninsula, which must be at least pre-jurassic. On the other hand, there may be a tectonic contact between the central and southern segments of the Peninsula, separating allochtonous regions with completely different geologic evolution.

The low value for the initial $^{87}Sr/^{86}Sr$ ratio of the basic rocks suggest strongly a direct contribution from the mantle, with little or no crustal contamination. A different explanation must be given for sample MD-57, whose analytical point falls well above the isochron line, and may be somewhat older than the plutonics rocks, or may have started with an initial ratio of the order of 0.708.

Two K-Ar results obtained on different mineral phases of the MD-58 gabbro yielded concordant results (108 and 116 Ma), and a Rb-Sr determination quoted by Halpern (1978) on the biotite of sample H-73-1, is also concordant with them. They indicate a significant thermal event occurred in the Early Cretaceous, at least in the southern part of the Mejillones Peninsula, and possibly related to a relevant metasomatic alteration, detected in the petrographic study of the gabbroic rocks.

CONCLUSIONS

Although the radiometric results here reported shall be considered preliminary, because they are not conclusive as regards to the entire evolution of the analysed rocks, the following comments can be made which impose constraints to the regional geologic history.

The Morro de Mejillones tonalite was emplaced probably during early Mesozoic times, and its terminal aplitic phases were formed at about 200 Ma. This shall also be considered the general aga of establishment of a contact aureole within the metamorphic rocks of the northern region.

The age of the regional metamorphism in the Mejillones Peninsula could not be determined, but there is some suggestion that it may be early Paleozoic. Sr^{87}/Sr^{86} initial ratios confirm the parametamorphic character of the mica schists of the northern region, and a possible ortometamorphic character of the gneisses of the central region.

A whole rock isochron of 200 Ma indicates the age of intrusion of the basic rocks of the southern region. The low Sr^{87}/Sr^{86} initial ratio of 0.7034 points to a mantle derived material.

The K-Ar results indicate a Jurassic regional cooling for the northern and central region, and a Lower Cretaceous regional cooling for the southern region, suggesting that they may constitute different tectonic blocks. Alternatively, the apparent ages of around 170 Ma and 110 Ma may be attributed to different tectonothermal events, whose tectonic significance still has to be determined.

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