GEOCHEMISTY AND PALAEOMAGNETISM OF IGNEOUS ROCKS FROM THE COSMELLI BASIN, SOUTHERN CHILE

N. PETFORD(1) & P. TURNER(2)

(1) Department of Earth Sciences, University of Liverpool, Liverpool L69 3BX, UK.
(2) School of Earth Sciences, Birmingham University, Birmingham B15, 2TT, UK.

INTRODUCTION

The Cosmelli basin, situated in southern Chile (ca. 46°S) is one of a series of continental Mid-Late Tertiary sedimentary basins that lie inboard of the present day subduction margin. The basin is located above a segment of continental crust that has experienced several ridge subduction events over the last 15 Ma. Subduction of a spreading mid ocean ridge (MOR) beneath continental lithosphere is a rare event and the potential effects of ridge subduction on the overriding continental (South American) plate are still poorly understood.

Recently, Flint et al., (1992) have interpreted the Cosmelli basin as a foreland basin that formed in response to ridge subduction processes. Facies relations within the basin show a sudden marine sediment to continental clastic transition, with intense folding and thrusting of the lower basin fill. Later basin fill material is relatively undeformed, and the overall stress regime during basin initiation and development is considered to be contractional (Flint et al., 1992).

The basin is host to a basic sill complexes and minor intrusives, and palaeomagnetic data implies that as a whole, the basin has suffered some kind of post depositional/intrusive thermal event. The basin also lies within the 'slab window' alkali flood basalt province of Ramos & Kay (1992). Given the proposed relation between ridge subduction, basin formation and magmatism, a study of the igneous rocks may help constrain the origin and thermal evolution of the basin.

IGNEOUS ROCKS

The igneous rocks of the Cosmelli basin range from basic sills to andesitic ignimbrites and dacitic stocks (Fig. 1a and Table 1). The data show some scatter on a silica K2O plot, with rocks ranging from low to high K (Fig. 1a). On Harker plots, the rocks form a fairly coherent group, with MgO, MnO, Fe2O3 and CaO showing a steady decrease with increasing SiO2 (eg. Fig. 1b).

GEOCHEMISTRY

XRF analyses for 9 igneous rocks are given in table 1. In Figure 1c, the dolerite sill SC-13 and a more evolved basaltic andesite (SC-32) are plotted together on a MORB-normalised trace element variation diagram. SC-13 (SiO2 49.1%) is much more primitive than SC-32 (SiO2 54.6), with K, Rb Cr and Ni approaching MORB values. Although typical of active margin rocks (ie. LIL and HFSE elements are enriched relative to MORB), they lack the distinctive Ta/Nb anomalies characteristic of subduction related magmas (cf. Andean high-Al calc-alkaline-arc basalts). The more basic rocks are similar in some ways to LIL-enriched 'Transitional" alkali plateau basalts from Patagonia (ie. Stern and others, 1990). On a Ba/La v La plot (Fig. 1d) the basic sills lie in a transitional region between island arc (IAB) and ocean island (OIB) basalts.

	SC-7	SC-11	SC-13	SC-16	SC-31	SC-32	SC-37	SC-59	CSM-2
SiO2	54.87	45.61	49.14	60.29	52.49	54.63	65.99	57.20	65.89
Al2O3	14.90	14.99	16.57	19.63	17.02	17.44	16.19	17.45	15.16
TiO2	0.81	1.15	1.25	0.92	1.21	1.16	0.72	1.24	0.73
Fe2O3	7.08	9.34	9.71	6.24	8.97	8.29	4.63	6.44	7.46
MgO	2.71	7.98	8.04	1.30	5.36	4.03	0.55	3.52	1.39
CaO	4.65	10.64	7.84	3.75	8.20	7.25	4.01	5.22	2.93
Na2O	4.51	2.78	4.47	4.43	3.45	3.80	3.76	5.22	3.61
K2O	0.21	0.15	0.17	1.51	1.94	2.05	0.31	1.04	0.33
MnO	0.17	0.15	0.16	0.02	0.16	0.15	0.06	0.08	0.14
P2O5	0.16	0.20	0.20	0.06	0.31	0.44	0.03	0.65	0.03
LOI	9.96	6.98	2.43	1.57	0.58	0.53	3.31	1.61	2.04
Ba	98	151	225	364	616	635	409	466	240
Ce	47	32	18	18	32	66	< 5	67	30
Cr	115	338	222	73	50	32	49	62	65
Cu	20	58	47	8	32	37	29	34	39
F	514	573	482	741	664	786	550	859	546
Ga	17	16	18	19	20	21	15	23	17
Hf	6	6	5	8	6	8	5	7	10
La	11	9	12	7	12	30	< 5	23	10
Mo	1	1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Nb	3	6	6	4	10	16	5	19	3
Nd	20	13	17	12	16	33	5	31	11
Ni	38	169	97	28	20	12	7	17	6
Pb	7	6	3	7	15	17	9	7	6
Rb	5	3	2	41	61	71	11	11	9
S	93	418	87	55	1234	110	571	463	290
Sc	27	34	30	23	27	20	20	19	11
Sm	6	12	< 2	4	9	7	8	2	14
Sn	2	2	< 2	2	3	< 2	< 2	< 2	2
Sr	271	445	544	433	701	768	317	575	240
Th	7	1	3	4	5	11	3	< 1	5
U	2	2	< 1	< 1	< 1	2	2	< 1	< 1
V	130	224	211	112	209	162	77	123	63
Y	18	18	19	21	25	24	18	18	18
Zn	56	60	59	32	71	65	67	103	74
Zr	128	83	87	127	106	189	124	273	147

Table 1. Major and trace element data for the igneous rocks of the Cosmelli basin

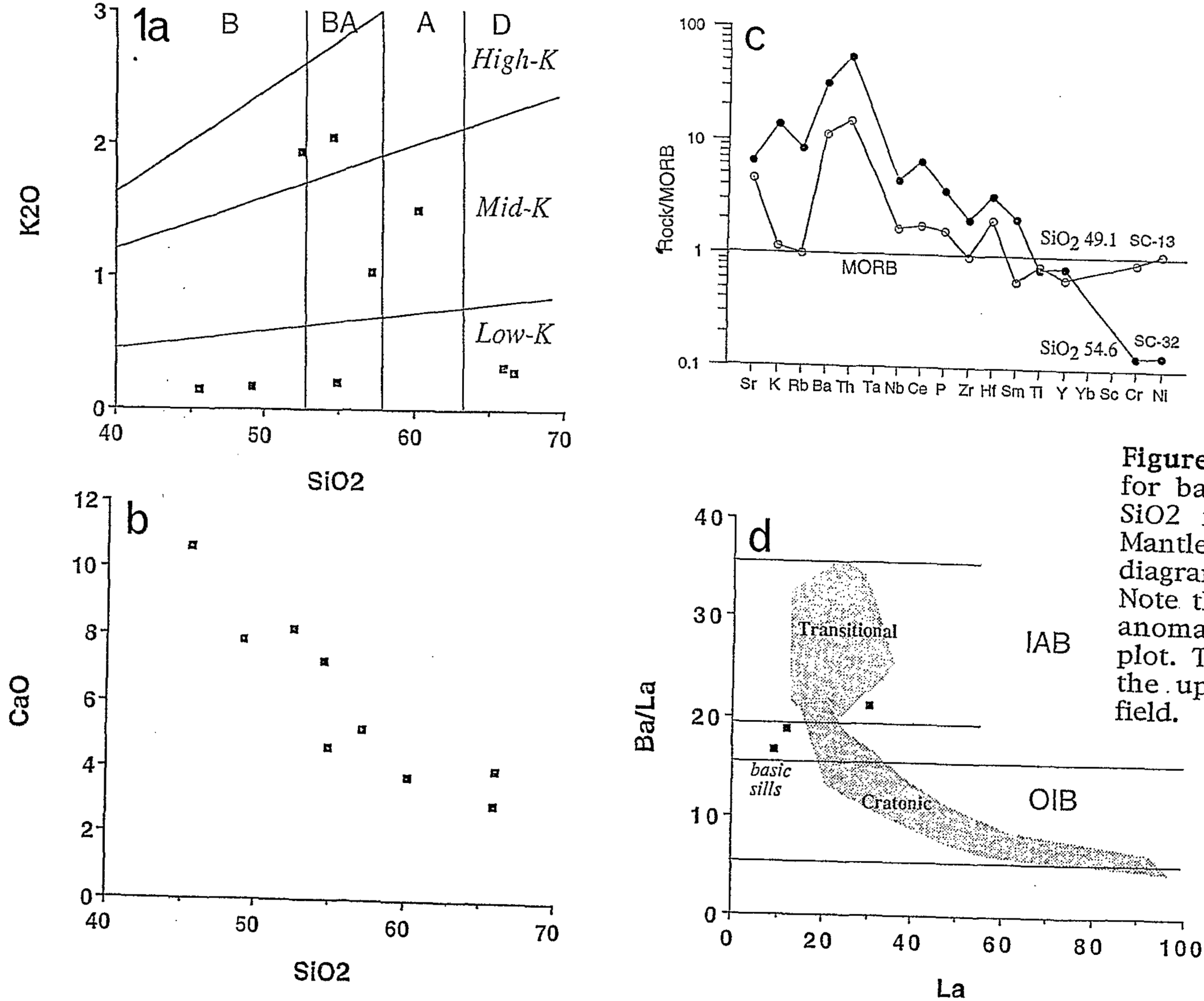

Figure 1a. K2O v SiO2 plot for basin rocks. **1b.** CaO v SiO2 for basin rocks. **1c.** Mantle normalised variation diagram showing basic sills. Note the lack of Ta and Nb anomalies. **1d.** Ba/La v La plot. The basic sills plot in the upper part of the OIB field.

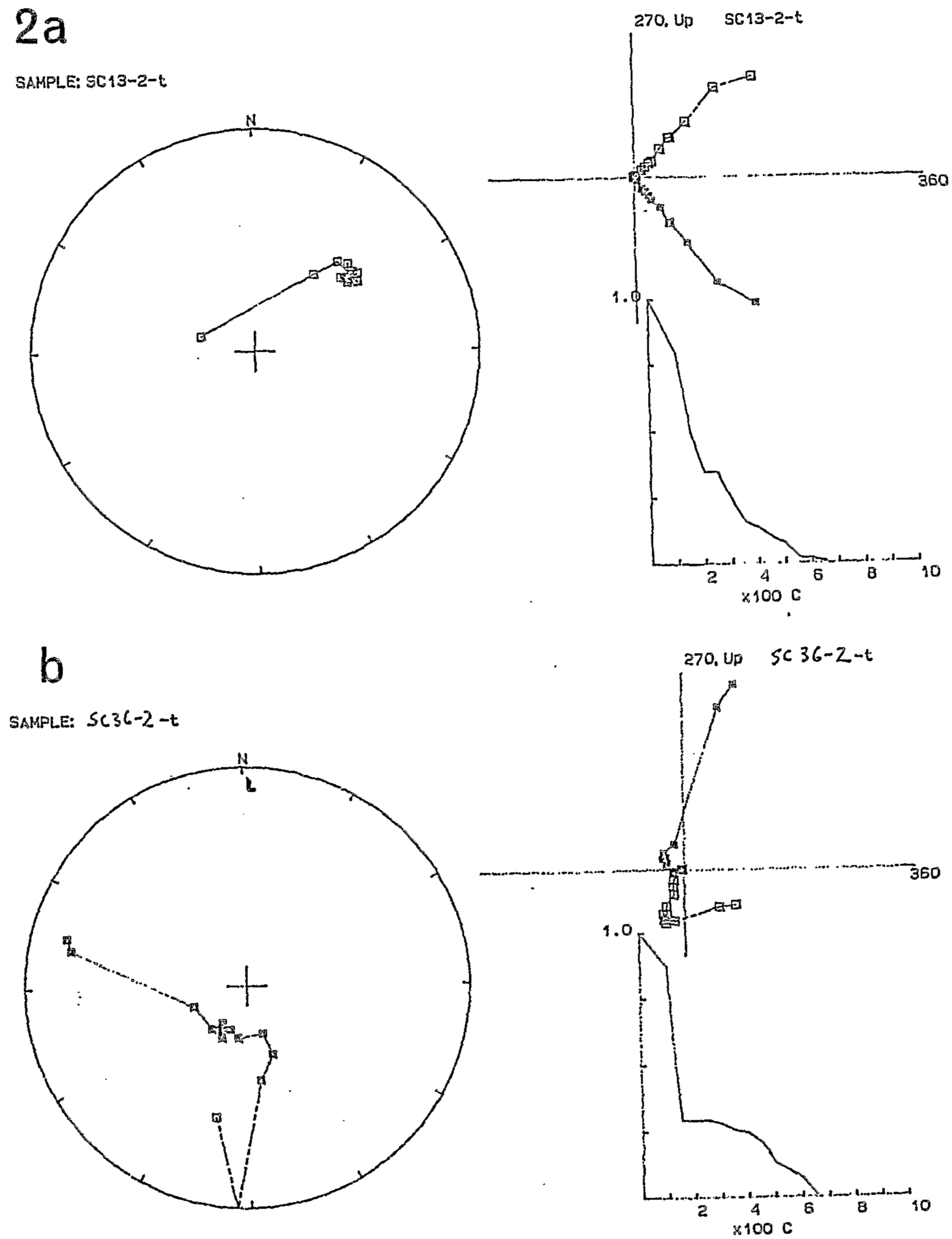

Figure 2a. Steregraphic and thermal demagnetisation plots for the dolerite sill located near the base of the Cosmelli basin. SC-13. **2b.** Same plots for basaltic andesite from higher in the sequence.

PALAEOMAGNETISM

Preliminary palaeomagnetic data for the sedimentary rocks suggest that the primary component is one of reversed polarity. In contrast, the igneous rocks show both reversed and normal polarity. Of particular interest is the dolerite sill sample SC-13 (Fig. 1c), from near the base of the sequence. It is a single vector showing superb demagnetisation characteristics. The rock has a remanence of reversed polarity, and the directions compare most closely with the Tertiary palaeofield before correction for tectonic dip. The basaltic andesite SC-32 from higher up the sequence is shown for comparison (Fig. 2b). One explanation for the normal polarity in the igneous rocks is that the magnetisation was acquired after folding.

DISCUSSION

Consideration of the palaeomagnetic data has led Flint et al., 1992 to conclude that the Cosmelli basin has been thermally overprinted during a normal polarity interval, and that the overprinting was in some way related to igneous activity - possibly coinciding with the extrusion of the voluminous "cratonic" plateau basalts to the east of the basin. Although the chemistry of the basic sills and associated volcanics precludes them from being directly related to the plateau basalts, neither are they classically calc-alkaline. The thermal 'pulse' and the presence of minor intrusives in the basin reflect elevated heat flow in the continental crust at the time of basin formation. The transitional nature of the basic sills is consistent with current models for ridge segment-related magmatism (Ramos & Kay, 1992).

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