zone region (e.g.Berckhemer 1968), giving us the opportunity to study a segment of deepest continental crust. The Ivrea zone consists mainly of amphibolite to granulite facies pelitic and mafic rocks. Spinel-peridotites are restricted to the highest grade part adjacent to the Insubric Line. The peak of metamorphism is considered to be due to the advective heat associated with these mafic-ultramafic intrusions. The metapelites show a considerable amount of partial melting and the so-called stronalithes (=granulite facies metapelites) are regarded as restites produced by "degranitization" of the metapelites (Schmid 1978). Rb-Sr determinations on restites and neosome, 30-50kg samples, give a 478±20 m.y. age, dating approximatly the peak of metamorphism (Hunziker and Zingg 1980). During this thermal event at least two phases of deformation can be discerned. Subsequent, cooling was very slow (≤2°C/m.y.) and high-T conditions lasted into Hercynian time as can be demonstrated in the phlogopite-peridotite of Finero (Hunziker and others, this conference). During this period of slow cooling, few retrograde, discontinuos reactions occur. However considerable retrograde cation exchange between neighbouring mineral grains is observed. Using T-estimates, the end of this retrograde cation exchange might be correlated with Rb-Sr data. Band isochrons yielding ages of approximately 350 m.y. give the end of Sr exchange at the cm scale.

F8

EMPLACEMENT AND CRUSTAL CONTAMINATION OF THE PERIDOTITES IN THE IVREA-ZONE

J.C. HUNZIKER, A. STECK, G. RIVALENTI, I. MERCOLLI and A. ZINGG
Min.-Petr. Institut, 1. Baltzerstr. 3012 Bern

Based on structural work combined with Rb-Sr, K-Ar, as well as main and trace element analysis on basic and ultrabasic rocks of the Ivrea zone, a multistage emplacement history of the peridotites must be postulated. A first granulite facies episode with at least 3 deformation phases is followed by a second amphibolite facies episode ending with a mylonisation; followed by a third episode of green schist facies deformation of presumably Alpine age.
Structural work shows that the peridotites already underwent a first deformation of lower Paleozoic age under granulite facies conditions, together with the surrounding metapelites. 2 different peridotites occuring in one and the same body can be distinguished. Hornblende peridotites and the different peridotites containing no phlogopite are characterized by low $^{87}Sr/^{86}Sr$ initial values around .7025 -.7035. (The same low87/86 ratios are found for the cogenetic gabbros), by Rb/Sr ratios lower than .02 and by high K/Rb ratios above 1000. On the other hand phlogopite peridotites have crustal Rb/Sr ratios between .2 and 2.0 and crustal K/Rb ratios around 250. These rocks revealed a Rb-Sr whole rock isochron with an age of 305± 10 m.y. and an initial $^{87}Sr/^{86}Sr$ ratio of .7062±5 (cogenetic gabbros show even higher Sr ratios). The analytical data of the phlogopite peridotite so far point to a crustal contamination, that according to structural criteria must have taken place at the end of the granulite facies episode.
Combining our Rb/Sr data on phlogopites as well as whole rocks, we can extrapolate from the present day $^{87}Sr/^{86}Sr$ ratio of the phlogopites over the initial ratio of the peridotite isochron 305 m.y. ago to the assumed Sr evolution curve of the mantle and the intersection of the two evolution curves, marks the time of the Sr contamination around 350 m.y. ago. This time mark coincides with the end of the small scale Sr homogenisation in the surrounding metapelites.

F9

PRE-ALPINE AMPHIBOLITE-FACIES METAMORPHISM IN SHEARED GABBROS OF THE ULTRAMAFIC LANZO MASSIF (INTERNAL WESTERN ALPS)

R. COMPAGNONI, *F. RADICATI di BROZOLO*, R. SANDRONE
Centro Studio Orogeno Alpi Occidentali, CNR, Via Accademia Scienze 5, 10123 Torino, Italy

The Lanzo Massif, one of the largest ultramafic bodies of the Alps, consists of a spinel/plagioclase lherzolitic core, with minor harzburgite and dunite, surrounded by serpentinized lherzolite and antigorite serpentinite (1). This massif, commonly considered as deriving from the upper mantle originally underlying the Insubric Plate, is now considered, due to the discovery of widespread early-Alpine H-P eclogitic parageneses, as part of the Western Alps ophiolitic belt (2). Within the peridotitic core, besides the well described gabbro and diabase dykes (3), a special type of mylonitic gabbro has been found, which is characterized by the presence of dark brown hornblende. The gabbro shows a polyphase pattern of HT deformation, and consists of olivine, clinopyroxene, orthopyroxene, plagioclase, ilmenite, apatite and brown hornblende (kaersutite to Mg-hornblende). Locally plagioclase is converted to jadeitic pyroxene + zoisite + quartz assemblage. Reconnaissance K-Ar dating was attempted on brown hornblende separates from the mylonitic bands. The apparent ages obtained range from 440 m.y. to 1650 m.y. and are most probably due to variable amounts of excess 40 Ar. The data do not fit on an isochron and no reliable age for the hornblendes can therefore be calculated. It is interesting to note that model Sm-Nd and Rb-Sr ages for Lanzo (4) fall in the same range. New dating experiments are needed to solve this problem.

Refs.: (1) NICOLAS, Thesis, Nantes, 299 p., 1966; (2) COMPAGNONI & SANDRONE, Rend. S.I.M.P., 35, 842, 1979; (3) BOUDIER, Thesis, Nantes, 163 p., 1976; (4) RICHARD & ALLEGRE, E.P.S.L., 47, 65-74, 1980.

F10

OROGENIC LHERZOLITES AS WITNESS OF MANTLE CONVECTION

M. POLVE and C.J. ALLEGRE
Laboratoire de Géochimie-Cosmochimie, Institut de Physique du Globe, 4 Place Jussieu, 75230 Paris 5

Orogenic lherzolite bodies are key places to study mantle heterogeneities and to try to understand these heterogeneities, as it is possible to have indications about geometric position of one sample compared to one another.

Our study has been done on the massif of Lherz (France), Beni Bousera (Morocco) and Lanzo (Alps).

Our results show important isotopic heterogeneities on the initial $^{87}Sr/^{86}Sr$ ratios of the lherzolites, even at small scale.

These heterogeneities are comparable to the one found on MORB.

All these observations coupled with Rb-Sr and REE data on whole rocks lead us to suppose that before being emplaced as orogenic lherzolite bodies,the mantle piece suffered a very complex geodynamic cycle where lherzolite suffer successive light partial melting events. Pyroxenites are created at different stades.

Thus, in the same mantle part are regrouped ultramafic and mafic rocks which were isotopically homogenized at different ages.

To decipher the history the only way is to date with Sm-Nd chronometers different kinds of mafic layers. This has been attempted. The preliminary results we have concern the last mafic layers created in the massifs : garnet clinopyroxenites in Beni Bousera, and gabbros in Lanzo. They give new informations about the tectonic emplacement of the lherzolite body.

F11

XENOLITHS OF PERIDOTITE, PYROXENITE AND ECLOGITE IN GRANULITE ROCKS OF PRE-HERCYNIAN UPPER MANTLE AND LOWER CRUST IN THE EASTERN BOHEMIAN MASSIF (CZECHOSLOVAKIA)

Z. MÍSAŘ, E. JELÍNEK, P. JAKEŠ
Charles University, Prague ; Geological Survey, Prague, Czechoslovakia

Garnet peridotites, peridotites, pyroxenites, and several types of eclogites form inclusions in pre-Hercynian garnet-kyanite (± opx) granulites. Mineral assemblages of inclusions, structural position and distinct reaction rims show that the xenoliths have been incorporated in the parental rocks of granulite before the metamorphic foliation took place.

The element distribution between garnet, orthopyroxen, clinopyroxen indicate relict temperatures and pressures corresponding to the upper mantle and lower crust conditions. Some of the inclusions however are of crustal derivation and exhibit the mineralogy corresponding to the upper crust.

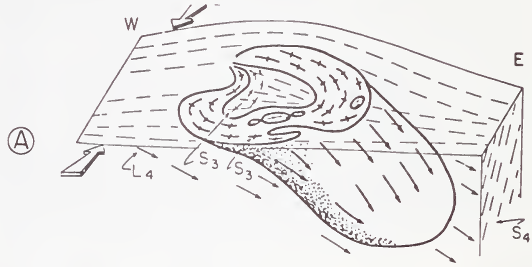
F12

CRUSTAL SINKING OF THE ALMKLOVDALEN GARNET LHERZOLITE BODY (NORWAY)

F. CORDELLIER and F BOUDIER
Laboratoire de Tectonophysique
Université de Nantes, 44072 Nantes F

The Almklovdalen ultramafic body included in the Basal Gneiss of Southern Norway is composed mainly of amphibolitized/chloritized harzburgite and dunite with cores of layered garnet lherzolite.

Parageneses show a retrograde evolution starting in upper mantle conditions : P = 17-28 kb, T = 645-820 C (fixed by Medaris, 1980), and evolving in lower crust hydrated conditions to P 7kb, T = 650-700 C.



Structures and microstructures indicate a continuum of deformation related with the paragenetic evolution, developed during the Svecofennian cycle (1400-1700 Ma).

Microstructural study emphasizes the role of fluids in favoring annealing of textures and enlarging the field of "low temperature" slip system in olivine.

Structural study related with gravity data suggest a geometry of "inverse diapir" (figure) developed by gravity sinking, during this evolution in lower crust conditions.