

- NOBILING R. (1983) - *High energy ion microprobes*. Nuclear Instr. and Methods in Physics Res., 218, 197-202.
- RAITERI F., VILLA M. (1981) - *Microanalisi a raggi-X di campioni massivi*. In: *Microscopia Elettronica a Scansione e Microanalisi*. Edito dal Laboratorio di Microscopia Elettronica, Istituto di Fisica, Università di Bologna. Coord. A. Armigliato e U. Valdrè, Parte II, Capitolo 1, 15-174.
- REED S.J.B. (1975) - *Electron Microprobe Analysis*. Cambridge Univ. Press, Cambridge.
- REMOND G., PICOT P., GIRAUD R., HOLLOWAY P.H., RUZAKOWSKY P. (1983) - *Contribution of electron spectroscopies to X-ray spectrometry applied to the geosciences*. In: *SEM/1983/IV*, SEM Inc. AFM O'Hare, Chicago, 1683-1706.
- RIBBE P.H., SMITH J.V. (1966) - *X-ray emission microanalysis of rock forming minerals IV. Plagioclase feldspars*. J. Geol., 74, 217-233.
- RINALDI R. (1979) - *La microanalisi elettronica: strumentazione ed applicazioni mineralogico-petrografiche*. Rend. Soc. It. Mineral. Petrol., 35 (2), 507-526.
- RINALDI R. (1981) - *La microsonda elettronica*. In: *Microscopia Elettronica a Scansione e Microanalisi*. Edito dal Laboratorio di Microscopia Elettronica, Istituto di Fisica, Università di Bologna. Coord. A. Armigliato e U. Valdrè, Parte II, Capitolo 3, 242-292.
- RINALDI R. (1982) - *More stacking variations in cancrinite-related minerals: how many more new minerals?*. J. Microsc. Spectrosc. Electron, 7, 76a-78a.
- RINALDI R. (1983) - *X-ray microanalysis*. Ultra-microscopy, 12, 97.
- RINALDI R. (1984) - *Mineralogy of natural zeolites: present status*. Proceedings 6th Internat. Zeolite Conf. Butterworth Scient. Publ. Co., 570-583.
- RINALDI R., WENK H.-R. (1979) - *Stacking variations in cancrinite minerals*. Acta Cryst., A35, 825-828.
- RUCKLIDGE J., STUMPF E.F. (1968) - *Changes in the composition of petzite (Ag_3AuTe_2) during analysis by electron probe*. N. Jb. Mineral. Mh., 61-68.
- SADANAGA R., TAKEUCHI Y., MORIMOTO N. (1978) - *Complex structures of minerals*. Recent Progr. of Nat. Sci. in Japan, Vol. 3, 141-206.
- STATHAM P.J. (1984) - *Accuracy, reproducibility and scope for X-ray microanalysis with Si(Li) detectors*. Jour. de Phys., Tome 45, Suppl. n. 2, C2, 175-180.
- TAKEYAMA T., OHNUKI S., TAKAHASHI H. (1982) - *Study of radiation induced micro-segregation in alloys by means of HVEM and EDX*. Electron Microscopy, Deutsche Gesellschaft für Elektronenmikroskopie, Frankfurt, Vol. 2, 273-275.
- WILLIAMS D.B., GOLDSTEIN J.I. (1981) - *Artifacts encountered in energy dispersive X-ray spectrometry in the analytical electron microscope*. In: *Energy Dispersive X-ray Spectrometry*. NBS Spec. Publ. 604, US Government Printing Office, Washington, 341-349.
- WITTRY D.B. (1980) - *Spectroscopy in microscopy and microanalysis: the search for an ultimate analytical technique*. Electron Microscopy 1980, P. Brederoo and V.E. Cosslett eds., Vol. 3, 14-21.

RIASSUNTI

RELAZIONI UFFICIALI

CZANK M.* - *Crystallographic and petrologic implications of HRTEM studies in chain silicates*.

One-dimensional linkage of corner shared $[\text{SiO}_4]$ tetrahedral leads to single chains. Condensation of a limited number M of single chains (or subchains) forms a multiple chain. M is the multiplicity of the chain which, in ordered chain silicates, has a value between 1 and 5. The number of $[\text{SiO}_4]$ tetrahedra within the identity period of a single chain (or subchain) is called its periodicity, P . Silicate chains with $P = 2, 3, 4, 5, 6, 7, 9, 12$ and 24 are known.

Some of the chain silicate phases are very rare or obtained only synthetically, while others are important rock forming minerals, such as pyroxenes ($M = 1, P = 2$), pyroxenoids ($M = 1, P = 3, 5, 7$ or 9) and amphiboles ($M = 2, P = 2$). The occurrence of specific chain periodicities and chain multiplicities, and consequently the existence of a certain mineral, strongly depends on chemical composition and on pressure-temperature conditions. Structural defects in these minerals may point out

reaction mechanisms as well as the baric and thermal history of the minerals (e.g. 1, 2).

In chain silicates three major types of faults can be observed by HRTEM (3): (i) fault caused by errors in the periodicity of the chains, i.e. chain periodicity fault (CPF); (ii) fault caused by chains of «wrong» multiplicity, i.e. chain multiplicity fault (CMF). Such faults have also been called chain width errors; (iii) fault in the periodic packing or arrangement of the chains leaving the chain characters P and M unchanged, i.e. chain arrangement fault (CAF). Such faults, known for a long time, were described as stacking faults, twin boundaries or planar antiphase boundaries.

Since the significance of CAFs in pyroxenes is well established, only results of recent studies on the augite-pigeonite exsolution will be presented as an example (4).

Natural and synthetic amphiboles (or more generally biopyriboles) contain a large variety of CMFs and CAFs. Analysis of CAFs point to new polytypes and that of CMFs to various polysomes and new structure types (2, 5). They also show that synthetic crystals often are poor analogs of natural amphiboles.

In pyroxenoids CPFs are more frequent than

CAFs. The analysis of the faults yielded new structure types and superstructures, helped to demarcate the stability field of ferrosilite III and allowed to conclude rapid cooling for a lunar pyroxferroite (6, 7).

REFERENCES

- (1) BUSECK P.R. et al. (1980) - Reviews in Mineralogy, 7, 117-211.
- (2) VELEN D.R. (1981) - Reviews in Mineralogy, 9A, 189-236.
- (3) CZANK M., and LIEBAU F. (1980) - Phys. Chem. Miner., 5, 85-93.
- (4) MÜLLER W.F. and MÜLLER G. (1984) - Fortschr. der Mineral., 62/1, 167-168.
- (5) MARESC H.V. and CZANK M. (1983) - *Periodico di Mineralogia* (Roma), 52, 463-542.
- (6) CZANK M. and SIMONS B. (1983) - Phys. Chem. Miner., 9, 229-234.
- (7) CZANK M. and LIEBAU F. (1983) - Lunar and Planetary Sc., XIV, 144-145.

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BARONNET A.* - *Polymorphism, polytypism, plastic deformation and phase-transformations in layer silicates.*

With regard to the great chemical and structural flexibility of layer silicates, these minerals are potentially good petrological markers of the environmental conditions under which they crystallize and/or deform.

During this lecture, most attention is paid to the behaviour of the mica group which is the most studied and also most probably the simplest among layer silicates. Combined hydrothermal syntheses and HRTEM studies (1) do indicate that the 1 Md → 1M → 2H₂ polymorph suite of muscovite is observed under increasing temperature conditions as noticed by the field geologist for illite from early diagenetic to early metamorphic rocks. At constant temperature, the same suite does occur in closed systems, in response to crystallization conditions approaching equilibrium. Grain-size examination of products indicates that such polymorphic transformations do not take place in the solid state but rather by a dissolution-recrystallization process called Ostwald ripening (2). The increase of the crystallinity index of illite may be explained by such a recrystallization process combined with progressive elimination of stacking faults. This leads to an increasing size of coherent domains as shown by powder X-ray diffraction.

Since no polytypic changes may occur in the micas by plastic deformation, long period polytypes of the micas are only indicative of growth events (3, 4). They are only found in natural trioctahedral micas like biotites, zinnwaldites and siderophyllites and characterize the spiral growth mechanism in fluid-rich magmas, metamorphic rocks and pegmatitic environments (5).

Microstructures of plastic deformation like bending and kinking will be shown and discussed for natural biotite and chlorite. A periodic glide process down to unit-cell scale accounts for kink formation

in both minerals. The geometry of kinks seems to be approached by deformation parameters but ultimately stabilized by a crystallographic control (6).

The mechanisms of phase-transformations among phyllosilicates are of interest for petrologists to know more about retromorphic events in metamorphic rocks and about weathering processes of igneous rocks. In the case of the biotite-chlorite conversion, evidences for a solid-state (7, 8) or a recrystallization process will be presented.

REFERENCES

- (1) M. AMOURIC and A. BARONNET (1983) - Phys. Chem. Minerals, 9, 146-159.
- (2) A. BARONNET (1982) - Estudios Geol., 38, 185-198.
- (3) A. BARONNET (1975) - Acta Cryst., A 31, 345-355.
- (4) D. PANDEY, A. BARONNET and P. KRISHNA (1982) - Phys. Chem. Minerals, 8, 268-278.
- (5) A. BARONNET (1984) - Fortschr. Mineral. (in press).
- (6) A. BARONNET and J. OLIVES (1983) - Tectonophysics, 91, 359-373.
- (7) J. OLIVES BANOS, M. AMOURIC, C. DE FOUQUET and A. BARONNET (1983) - Amer. Mineral., 68, 754-758.
- (8) D.R. VELEN and J.M. FERRY (1983) - Amer. Mineral., 68, 1160-1168.

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ALTRE COMUNICAZIONI ALLA
TAVOLA ROTONDA

VENIALE F.*, CAUCIA F.*, COCITO S.*, GERMANI A.*, SETTI M.*, SOGGETTI F.*, VACCHINI L.*, ZEZZA U.* - *Alcune applicazioni della microscopia elettronica nello studio di materiali argillosi.*

La microscopia elettronica nelle sue diverse potenzialità (TEM, SEM, diffrazione, microsonda) è una metodologia che è venuta trovando sempre maggiori applicazioni nello studio di materiali argillosi.

1. - Correlazioni fra composizione mineralogica (in particolare distribuzione dei « minerali argillosi ») e tessitura (« fabric », « Gefüge ») di formazioni argillose e/o con componenti argillose dell'Appennino (argille « varicolori », flysch, marne, arenarie, ecc.); inoltre, influenza dell'arrangiamento spaziale delle particelle sul comportamento meccanico e idraulico, dipendentemente dal grado di alterazione meteorica, dall'andamento dei cicli di umidificazione/essiccamento e dalla natura-concentrazione degli elettroliti nelle soluzioni interstiziali.

2. - Sequenze di « weathering » di rocce vulcaniche acide (rioliti, ignimbriti), graniti e gneiss nell'area fra la Val Sesia e il lago Maggiore; influenza della struttura-tessitura della massa di fondo della roccia madre sulla natura dei minerali argillosi (allofane, gibbsite-boehmite, para-halloysite-meta, kaolinite) presenti nei prodotti di trasformazione. Riconoscimento della imogolite come fase incipiente iniziale del degrado di cristalli feldspatici.

3. - Indicazioni sui procedimenti di lavorazione e sulle temperature di cottura di ceramiche antiche