FLUID INCLUSIONS IN QUARTZ, BERYL AND APATITE FROM THE FORCAREY-SUR PEGMATITE FIELD (SPAIN)

FUERTES, M (1); MARTIN-IZARD, A(1); MANGAS, J(2)

(1) Department of Geology. University of Oviedo. 33005 Oviedo, Spain
(2) Department of Physic. University of Las Palmas, Tafira. 35080 Gran Canaria, Spain

The Forcarey-Sur pegmatite field is located between the towns of Cerdedo and Avion in northwestern Spain. In this area there are several north-south-trending pegmatitic and pegmoaplitic outcrops which are contained within a narrow belt of metasedimen-tary rocks (Paraño Group). The pegmatite field is associated with two-mica or muscovite peraluminous synkinematic granites which are affected by the third tectonic phase of the Hercynian Orogeny and crop out to the west of the pegmatites.

The pegmatites and pegmoaplites of the Forcarey-Sur pegmatite field belong to the LCT (Cherny, 1993) family, and within this to the rare-elements type. These rocks have a number of field, mineralogical, textural and geochemical characteristics which allow them to be divided into five different groups (A, B, C, D and E) (Fuertes et al. 1994). These groups occur in such a way that the degree of differentiation increases progressively from the west to the east; the least developed pegmatites (groups A and B) being found nearest to the western granite complex, and the most developed ones (group E) furthest from it. The most fractionated pegmatites (groups D and E) contain Sn-Nb-Ta in the form of columbite, tantalite and tantaliferous cassiterite. This mineralization appears in replacement aplitic units of albite-rich pegmoaplites.

The fluid-inclusion study was undertaken using microthermometry on quartz, beryl and apatite from a replacement aplitic unit of a pegmatite of the group E. This aplitic unit is rich in cassiterite and columbite-tantalite. The number of inclusions studied is 60 in quartz, 50 in beryl and 30 in apatite.

Based on the estimated composition on the trapped fluid using microthermo-metric data only one type of inclusion fluid has been defined: complex aqueous inclu-sions (H_2O-NaCl-CH_4-CO_2). These inclusions show two phases at room temperature. CH_4 homogenisation can not observed and its presence has been detected by formation of hydrate, which mels above 10° (10.8°C to 16°C). CO_2 nucleation temperature (-105°C /-118°C) was observed in ten inclusions and CO_2 melting temperature was measured in three inclusions (-60.7°C, -60°C, -59°C). These nucleation and melting temperatures are consistent with the presence of CH_4. The fact that CO_2 and CH_4 phase transitions can not observed is probably due to their low density.

The temperature of initial melting of ice, where measurable, was generally close to the eutectic for the system NaCl-H_2O (-20.8°C; Potter & Brown, 1977). These results suggest that the aqueous solutions contain mainly Na in solution, and belong to the H_2O-NaCl system. The exclusion of NaCl from the clathrate lattice results in artificially high salinities in the aqueous phase of the inclusions while CH4 hydrate is present. Thus, measurement of the melting point of ice yields falsely high values of wt.% eq. NaCl. Although the use of wt.% eq. NaCl in such inclusions seems inappropriate, the salinity based on final ice melting with reference to the system H_2O-NaCl (Potter et al.,1978) has been estimated.

Based on volumetric relations and homogenization temperatures three subtypes of inclusions have been distinguished:

<u>Subtype IA</u>. These inclusions are scarce, they appear isolated or in groups, and are interpreted as primary. The morphology of the inclusions is variable, commonly being elongated or subhedral negative crystal. The size of

the inclusions ranges between 4 and 10µm. These inclusions show Vg/Vt ratio of about 50%-80% and homogenisation temperatures between 360°C and 370°C (in the gas or critical state and two inclusions in the liquid state). This degree of variability in the pattern of homogenisation can be explained by small differences in the bulk composition of the fluid because these inclusions don't present characteristic of boiling process. The final ice melting temperature ranges between -1.8°C and -3°C (3.05 - 4.94 Wt. % eq. NaCl).

Subtype IB. These inclusions are the most abundant in quartz and beryl. They appear commonly in parallel planes, and are interpreted as secondary or pseudosecondary. Inclusions morphology is varied, being irregular or subhedral negative crystal. The size of the inclusions ranged from 4 to 12µm. The vapour phase occupies 20%-30% and homogenisation temperatures range between 270°C and 345°C in the liquid state. The final ice melting temperature ranges between -0.8°C and -3.8°C (1.39 - 6.14 Wt. % eq. NaCl).

Inclusions in apatite are included in this subtype. They are found distributed in healing fractures or isolated. Inclusions in fractures have negative crystal morphology, size ranged from 7 to 10µm and the vapour phase occupies between 10% to 20%. Isolated inclusions are irregular to rectangular form, sizes varying between 15µm and 20µm and the vapour phase occupies between 30% to 40% . The homogenisation temperatures range between 273°C and 310°C in the liquid state. The final melting temperature of ice values ranges between -2.2°C and -3.9°C (3.69 - 6.29Wt. % eq. NaCl).

Subtype IC. These inclusions are more abundant in beryl than quart. They appear distributed in healing fractures. Inclusions morphology is varied, being irregular, elongated or subhedral negative crystal, and are interpreted as secondary. The size of the inclusions ranged from 4 to 10µm. The vapour phase occupies 5%-10% and homogenisation temperatures range between 200°C and 247°C in the liquid state. The final melting temperature of ice values ranges between -1.1°C and -1.9°C (1.90 - 3.21 Wt. % eq. NaCl).

The microthermometric data are summarised in Table 1.

HOST MINERAL	INCLUSION TYPE	Vg/Vt	Th °C	Nº	Tm$_{ice}$ °C	Tm^{CO_2} °C	Tm$_{hydr.}$ °C
QUARTZ	IA	50-75%	360L 365 to 370G 365 to 370C	10	-2.1 to -3	-60	13.4 to 13.8
	IB	20-30%	270 to 345L	43	-1.8 to -3.8	-59 to -60.7	10.8 to 16
	IC	5-10%	230 to 245L	7	-1.1 to -2.1		10.8 to 11
BERYL	IA	70-80%	360 to 370G 362C	7	-1.8 to -2	—	11 to 12.4
	IB	20-40%	270 to 328L	23	-0.8 to -1.8		11.2 to 12.4
	IC	5-10%	200 to 247L	18	-1.1 to -1.9		11.2 to 13
APATITE	IB	5-10% 30-40%	273 to 310L	20 10	-2.2 to -3.9	—	—

From the above microthermometrical data clearly no significant differences exist among the fluid inclusion populations in quartz, beryl and apatite. Three discontinuous trapping stages of fluid inclusions can be distinguished with progressively lower homogenization temperatures. Only one fluid composition has been approximated, a low-salinity aqueous fluid with CH4 and CO2. This fluid may have been responsible for the albitic metasomatism of the pegmatitic body and associated Sn-Nb-Ta mineralization. Fluids with similarity composition has been described in fluid inclusions from metasomatic minerals in border unit of The Tanco zoned granitic pegmatite (Thomas et al., 1990).

Bibliographic references
CERNY, P. (1993). Ore deposit models vol II. Geoscience Canada, 29-48.
FUERTES, M. & MARTÍN-IZARD, A. (1994): *Boll. Soc. Esp. Min.* **17**, 51-63.
POTTER, R. W. & BROWN, D.L. (1977): *U.S. Geological Survey Bulletin*, 1421-C.
POTTER, R.W.; CLYNNE, M.A.; BROWN, D.L. (1978): *Econ. Geol.* **76**, 284-285.
THOMAS, A.V.; PASTERIS, J.D.; BRAY, C.J.; SPOONER, E.T.C. (1990): *Geochimica et Cosmochimica Acta* **54**, 559-573.