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Eric Gloaguen, G. Ruffet, Patrick Monié, Yannick Branquet, Alain Chauvet, Vincent Bouchot

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GEOCHRONOLOGICAL CONSTRAINTS ON THE MAGMATIC AND HYDROTHERMAL EVOLUTION OF THE TRAS-OS-MONTES HERCYNIAN DOMAIN (GALICIA, SPAIN): POSITION OF THE AU, SN-W MINERALIZING EVENTS

E. Gloaguen[a], **G. Ruffet**[b], **P. Monié**[c], **L. Barbanson**[a], **Y. Branquet**[a], **A. Chauvet**[c] **and V. Bouchot**[d]

[a] *Institut des Sciences de la Terre d'Orléans (ISTO), UMR 6113 CNRS/Université d'Orléans, Bâtiment Géosciences, Rue de Saint Amand, BP 6759, 45067 Orléans Cedex 2, France.* *eric.gloaguen@univ-orleans.fr;* *luc.barbanson@univ-orleans.fr;* *yannick.branquet@univ-orleans.fr*

[b] *Géosciences Rennes, UMR CNRS 6118, Bâtiment 15, Université de Rennes1, Campus de Beaulieu, CS 74205, 35042 Rennes Cedex, France. gruffet@univ-rennes1.fr*

[c] *UMR 5573 - Dynamique de la Lithosphère, ISTEEM, Université Montpellier 2, CC. 60, 34095 Montpellier cedex 5, France. monie@dstu.univ-montp2.fr; chauvet@dstu.univ-montp2.fr*

[d] *BRGM, 3, avenue Claude Guillemin, BP6009, 45060 Orléans Cedex 2, France. v.bouchot@brgm.fr*

Travaux réalisés dans le cadre du GdR Transmet

1. Introduction and geological setting

The study area is located in the Galicia-Trás-os-Montes Zone (GTMZ zone, Arenas et al. 1986, Fig. 1), that belongs to the internal zone of the Hercynian belt and is composed of a relative autochthonous and parautochthonous units overthrusted by allochthonous complexes (Ribeiro et al. 1990). This domain of Palaeozoic schists is affected by a low to high temperature – medium pressure metamorphism. These rocks exhibit a well-developed regional schistosity related to nappes emplacement (D1 and D2 events) and are affected by NS-trending crenulation lineation and folds (D3 event) The late D3 event is characterized by a high-temperature metamorphism leading to development of local migmatite. Both parautochthonous and allochthonous units are intruded by syn- and post-kinematic plutons. Four generations of granites (G1 to G4) are identified by their textural and geochemical characteristics and by crosscutting relationships. Gold deposits are spatially associated with the G3 granites whereas Sn-W deposits are represented, in the study area, by disseminated and vein-type mineralization spatially close to the G2 granites (fig. 1).

2. Methodology

$^{40}Ar/^{39}Ar$ dating of micas has been performed on selected separate monograins of crushed samples at Rennes1 and Montpellier University using the laser step-heating method described by Ruffet et al. (1991). Muscovite of mineralized quartz veins have been analyzed whereas muscovite and biotite are selected from granites. Monazites have been extracted from crushed granite samples using dense liquors and handpicked under a binocular microscope. After inclusion and preparation of a polish section, 20 grains have been selected by BSE (Back Scattered Electron) investigation (5 by granite generation) from an initial population of 600 grains for all granites. EPMA transects have been performed on selected grains using procedure and method described by Cocherie and Albarede 2001. Mineralogical characterization of monazite grains has been performed using: i) textural evidences (BSE images); ii) chemical evolution and

characteristics (transects core-edge); iii) chemistry differences; iv) substitution differences. All these parameters allow the separation of data in two distinct sets (core vs edge) for each analysed grains (see example fig. 2).
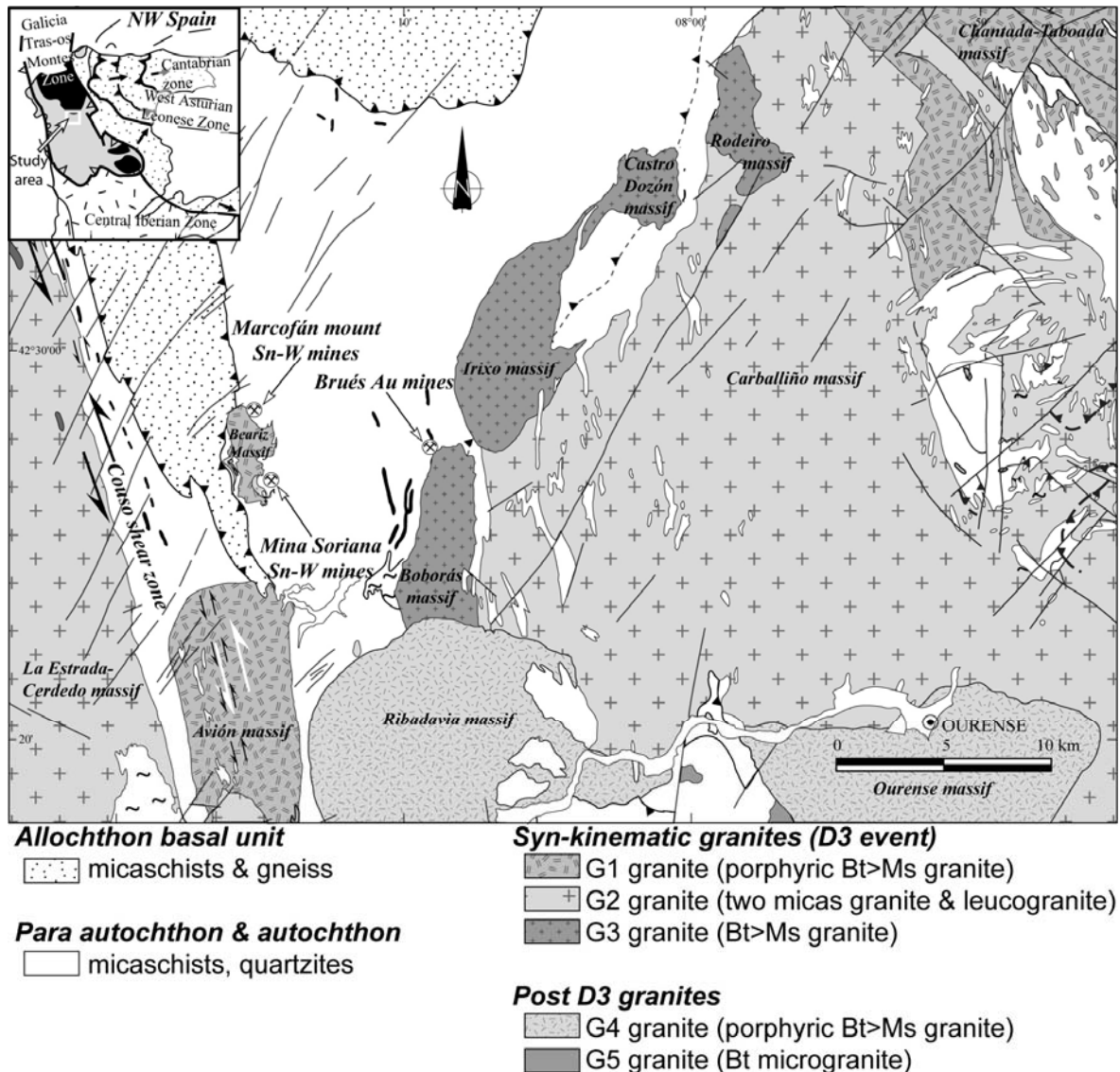

Fig. 1. Localisation of the studied area in NW Spain (inset on the top left corner) and geological map of the studied area. Localisation of the main Au and Sn-W vein-type deposits are also indicated.

3. Results
Ar/Ar method
Ar/Ar results are consistent for all the analysed samples and summarized within the figure 3. Ages are bracketed between 292 and 302 Ma except for the G1 Chantada granite that yield ages close to 307-309 Ma. When they are well-defined, age plateau are very close for muscovite and biotite minerals. Because some plateau exhibit evidences for Ar loss, the existence of a late thermal event that can reset Ar within mica is strongly suspected.

Monazite dating
All the analysed monazites present inherited cores (fig. 2) except from those of the Ridabavia granite (G4) that exhibit texture of recrystallization that can erase

core and rim zoning. Two distinct ages are obtained for each sample with respect to core or rim analysis (see figure 3). Ages given by the cores are systematically older than those of the edges.

Taking into account that the crystallisation is given by rim analysis, granites are respectively dated, from older to younger at, 331 Ma (G1), 322 Ma (G2), 318 Ma (G3) and 303 Ma (G4). Note that these ages are consistent with those of the literature.

Discussion

In the light of the results herein presented, 2 alternatives can be proposed and discussed.

-First, the ages given by the monazite were not considered because of the large uncertainty that subsists concerning this method and by the fact that all the monazite grains are zoned. In that case, and because Ar/Ar ages are very close for biotite and white mica, we can suggest that cooling of the granite was very rapid and that ages given by the Ar/Ar method were close to the age of magma crystallisation. This hypothesis implies a very short and concentrated magmatic history, coeval with the formation of hydrothermal features just after this event, at about 298 Ma.

-Second, the ages given by monazite edge were considered as reflecting the age of magma crystallisation. The magmatic story was then developed along an interval of ca. 40 Ma, hypothesis more consistent with that of the other segments of the Hercynian orogen.

Indeed, the Ar/Ar ages can then be interpreted either by a complete
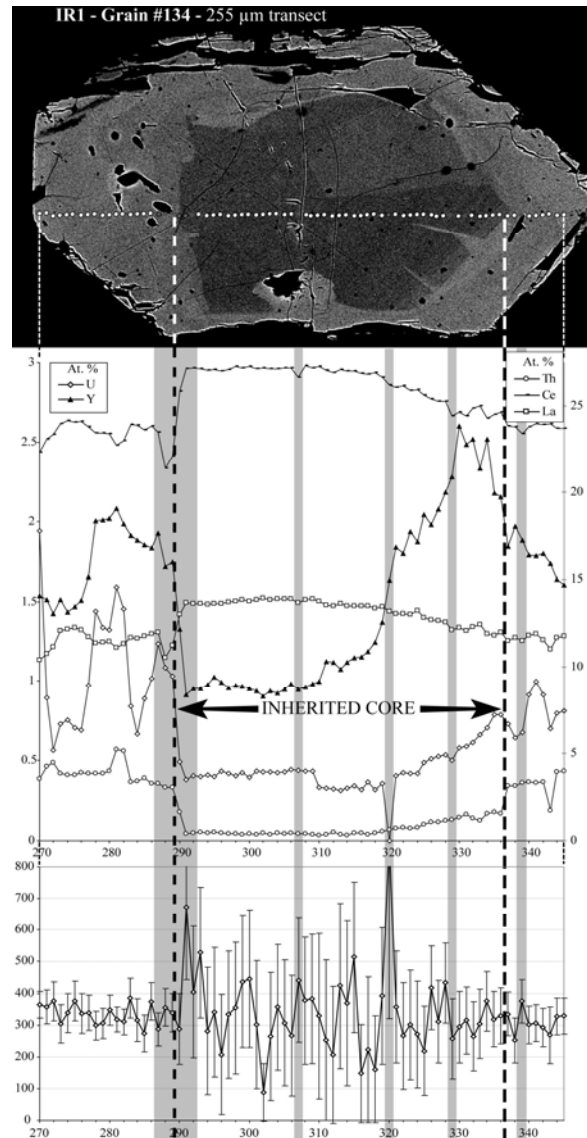

Fig. 2. Example of zoned monazite with inherited core. Chemical and apparent ages transects of the grain are below the BSE image. Rejected points are in half tone. Note the difference between the edges of grain (average of punctual age's well-defined, low uncertainty) and the core of the grain, highly variable.

resetting of Ar within micas, due to the emplacement of the late G4 granite (close to 300 Ma), or by reflecting the cooling age through temperature of 300-400°C, posterior to the nappe emplacement. In all the case, the age of the mineralization remains uncertain.

In conclusion, a model of the tectono-magmato-hydrothermal evolution of the studied area will be proposed and discussed with the help of others constraints (mineralogy, structure, regional geology) and in order to relocate and date the formation of Sn-W and Au mineralizations within.
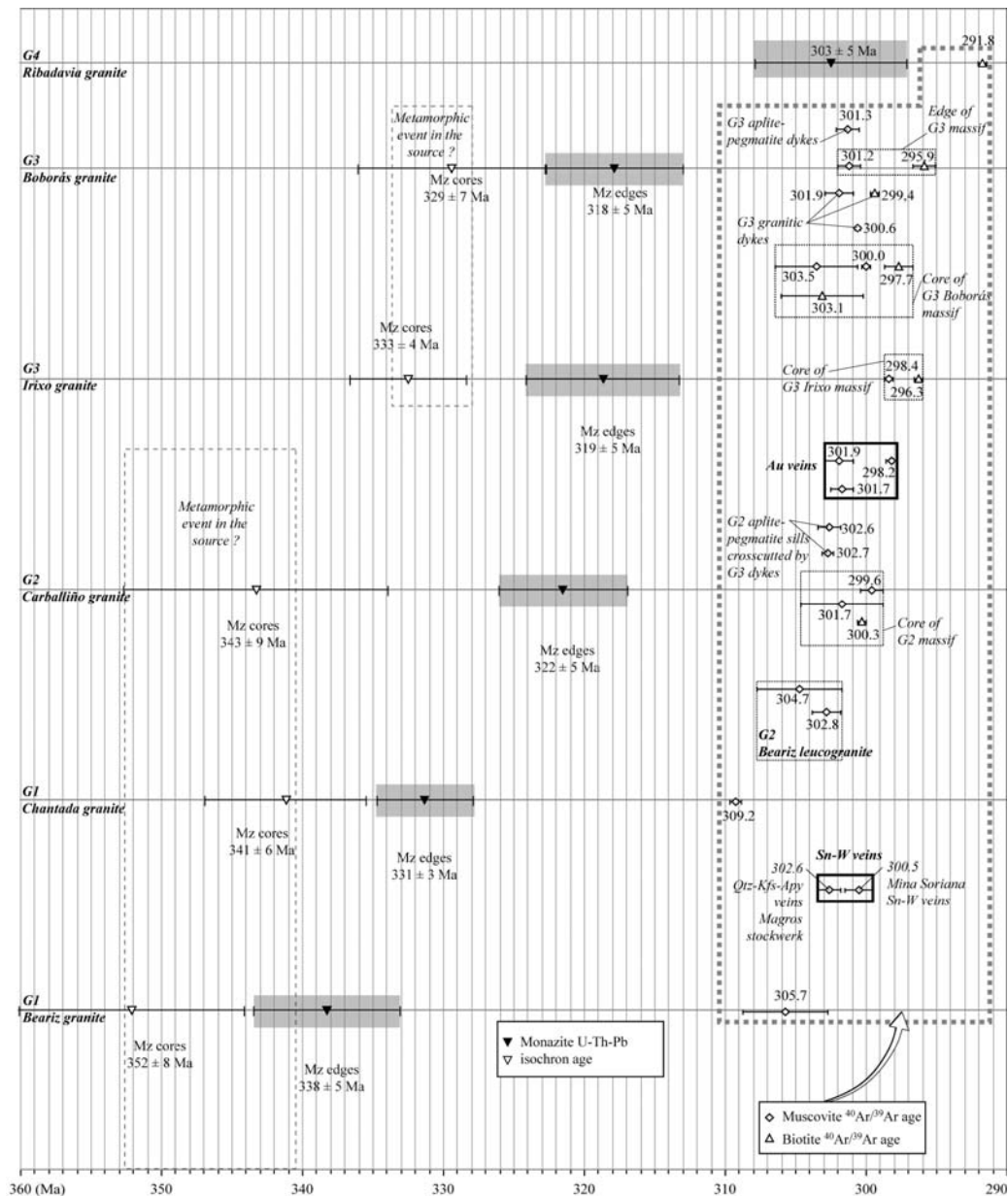
Fig. 3. Synthesis of the ages obtained by $^{40}Ar/^{39}Ar$ method on granites and mineralization and EPMA ages on monazite (U-Th-Pb isochron ages) on granites. Granites emplacement ages are given by ages of monazites edges, metamorphic event in the sources of granites are given by ages of monazites cores.

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