GENESIS OF PSEUDOTACHYLITE VEINS IN THE BASEMENT OF THE ROCHECHOUART IMPACT CRATER, FRANCE. II. GEOCHEMICAL EVIDENCE AND A GENETIC MODEL.

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Ten petrographically well-studied (1) samples of pseudotachylite-bearing vein fillings from the subcrater basement of the Rochechouart meteorite crater were subjected to a study of their major element abundances (XRF), Rb and Sr concentrations, and Rb-Sr isotopic compositions (MS). In addition, the three host rock varieties - microgranites of variable quartz (34-44 vol%), alkalifeldspar (23-35 vol%), plagioclase (22-27 vol%), and muscovite (.7-3.5 vol%) contents and degree of sericitization - were analysed.

<u>The results:</u> XRF analytical data are compiled in Table 1. From the comparison of SiO_2, Fe_2O_3, CaO, and MgO data of granites and pseudotachylite samples it is evident that it was impossible to prepare pure PT separates, and that in addition, various amounts of quartz, pyrite, calcite, and dolomite were analysed, too. Interelemental correlations - even after corrections for excess mineral contents had been applied - can not be found, only K_2O (and Rb) correlates with Al_2O_3 for a few of the PT samples (Fig. 1). Specimens 2a and 2b are clearly distinct from the others, but on the basis of mineralogical and geochemical data, no explanation can be offered so far for their eccentricity, or for that of samples 4/1 and 4/2 (Fig. 1). Within acceptable limits, a weak correlation of Rb/Sr ratios (or Rb concentrations) and Al_2O_3 can be established. This leads us to the conclusion that variations are due to different amounts of muscovite or alkalifeldspar in the parent rocks. Sr concentrations (Table 1, Fig. 2) are rather uniform, and the low values analysed can not be explained by simple admixing of 10 or 20 vol% (cf. Table 1) of quartz and pyrite (1). Contrary to this, Fig. 2 shows the very variable Rb concentrations, an explanation for which was given above.

Rb-Sr isotope data of pseudotachylites produced by tectonically induced melting of parent rocks should be comparable to the isotopic compositions of their precursor rocks. In Fig. 3 a 265 m.y. <u>isochron</u> is presented for three whole rock granite samples, which were collected in immediate contact to PT-containing veins - just outside the sericitization zone. The age of 265 m.y. represents the end of the last period of granitisation in the Massif Central - as determined in a regional study by (2). Between the end of this period and the impact event of Rochechouart at 186 m.y. ago (3) no other geological event could be detected. Despite this, a well-defined <u>pseudo-isochron</u> can be calculated for 7 PT-containing vein fillings with a slope that corresponds to an apparent age of 217 ± 8 m.y.. Only samples 4/3 (secondary carbonates!), and 2a and 2b (see above) yield dissenting results that are not easily explained. All ten vein samples display very similar concentrations of radiogenic ^{87}Sr (mean value$_{(10)}$ = .0148 ± .005 (1σ) [µmole/g], which is not in agreement with the highly variable $^{87}Rb/^{86}Sr$ ratios (Fig. 3). Therefore the best-fit line of Fig. 3 is no true isochron!

No hypothesis to explain our isotopic results either by partial diffusive equilibration between host rock and vein fillings or by mixing of 265 m.y. old material with young secondary phases can sufficiently explain, why Sr has been removed to a more or less uniform degree and why a well-"equilibrated" isotope system was formed.

<u>Our theory:</u> A high-pressure pneumatolytic medium - a mixture of cataclastic debris, frictional melt, and fluid phase - completely filled the vein system! Ca, Sr, and of course ^{87}Sr, was extensively dissolved (as shown by the sericitization of the neighbouring host rock (1)) and carried off - some might have been redeposited within the veins as coarse-grained (!) carbonate aggregates. This theory is based on a large number of petrographical observations (1) and is in our opinion the only possible explanation for the formation of an isotopically homogeneous (^{87}Sr) multi-vein system of $^{87}Rb/^{86}Sr$ ratios varying from 5 to > 60 (Fig. 3).

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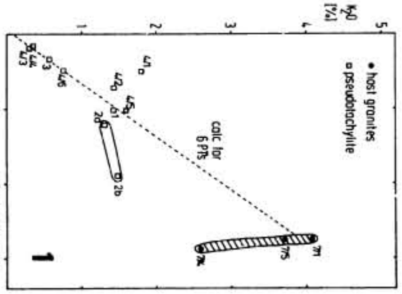
The formation of this special vein system involved the following four steps:

1. **lateral tectonic movements** triggered by the impact of the Rochechouart meteorite (186 m.y. ago) locally produce pseudotachylitic melt and clastic breccias of weak shock metamorphism (1);
2. **mixing** of clastic and molten material with a fluid medium circulating in the subcrater fracture systems under high p_{H_2O} and intermediate temperature (~ 700 °C, (1) conditions;
3. crystallization of hydrothermal quartz and Fe-sulfides, corrosion of clasts, crystallization of new phases (orthoclase, Fe-pyroxene, sulfides) in melt pockets (1), recrystallization of clasts characterise this **cooling period**; the fact that rapidly quenched glassy melt pockets contain severely corroded clasts (4) can be understood more easily, if the presence of an aggressive high-pressure aqueous phase is considered;
4. **post-genetic formation of carbonate veins** cutting through PT-containing veins; carbonaceous solutions infiltrated from higher levels of the impact crater, and the generally fine grain size is explained by rapid crystallization from relatively cool solutions.

References: (1) Reimold, W.U. et al. (1984) Genesis of pseudotachylite veins....I. Geological and petrographical evidence (this volume); (2) Reimold, W.U. et al. (in prep.) Petrography and chronology of amphibolites and granitic rocks from the Haut-Limousin (France); (3) Reimold, W.U. et al. (1984) The Rochechouart impact melt: Geochemical implications and Rb-Sr chronology (this volume); (4) Reimold, W.U. et al. (1983) LPS XIV, 636-637.

Tab.1: XRF-analysis of granitic host rocks (sample 7/1 to 7/5) and PT-veins (P-1 to P-4); major elements in wt% and Rb, Sr in ppm

	7/1	7/4	7/5	P-1	P-2A	P-2B	P-3	P-4/1	P-4/2	P-4/3	P-4/4	P-4/5	P-4/6
SiO_2	77.58	69.55	73.58	79.50	70.55	73.24	n.d.	n.d.	n.d.	51.60	57.30	83.33	84.86
TiO_2	.08	.10	.17	.02	.26	.49	n.d.	n.d.	n.d.	.02	.02	.01	.00
Al_2O_3	13.74	14.39	13.76	5.08	6.12	9.46	1.68	2.53	3.59	.95(?)	.80	5.13	2.40
Fe_2O_3	.46	3.80	.84	2.46	8.14	8.45	13.03	2.25	1.59	3.74	3.27	2.52	2.49
MnO	.02	.04	.01	.07	.12	.12	n.d.	n.d.	n.d.	.24	.22	.04	.05
MgO	.79	1.39	.62	3.01	3.81	3.89	.13	1.12	2.58	9.21	8.42	1.68	2.39
CaO	.72	.50	.98	2.73	2.09	.65	.04	1.69	3.57	12.70	10.98	2.42	3.29
K_2O	4.08	2.58	3.73	1.43	1.30	1.48	.57	1.79	1.43	.30	.35	1.59	.76
Na_2O	n.d.	2.73	3.33	.57	.08	.08	.01	.03	.38	.07	.04	n.d.	n.d.
P_2O_5	.02	.16	.05	.01	.05	.08	n.d.	n.d.	n.d.	.02	.01	.02	.00
glow loss (1000°C)	1.70	2.89	2.58	5.80	6.00	3.36	n.d.	n.d.	n.d.	21.22	18.59	2.40	4.40
Total	99.20	98.26	99.60	100.70	100.20	101.50	-	-	-	100.00	100.70	99.10	100.50
Rb	484.4	209.0	174.5	87.6	17.8	144.5	48.0	203.6	127.6	193.9	33.7	444.1	155.1
Sr	428.9	72.6	148.4	29.2	11.5	9.5	11.1	11.8	22.4	21.7	17.1	21.0	12.2



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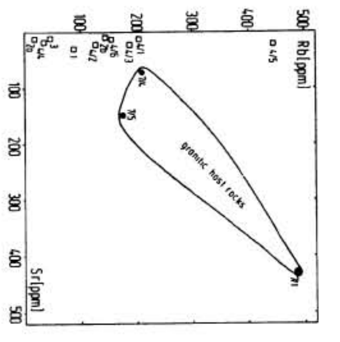

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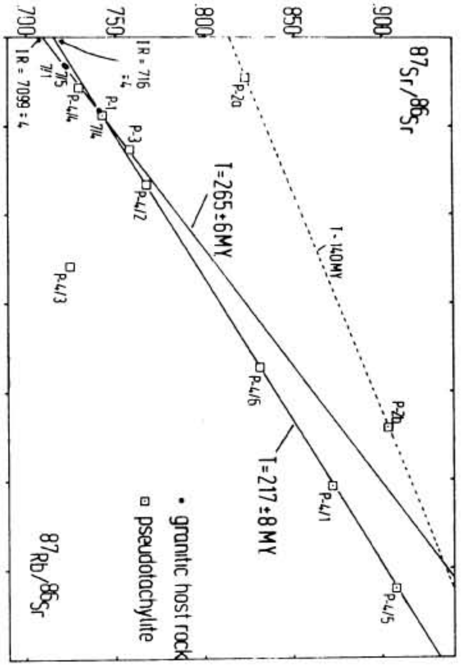

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