PETROGRAPHIC AND GEOCHEMICAL STUDIES ON THE BASEMENT ROCKS OF THE ROCHECHOUART METEORITE CRATER, FRANCE, AND PSEUDOTACHYLITE THEREIN.

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The geological sketch map of Fig. 1 - based on the work of Lambert (1) and Oskierski (2) - shows that the main probable target rocks from which the impact melt of the Rochechouart crater might have been formed are gneisses, granites, leptynites, and minor amounts of diorite. Occurrences of amphibolite (and serpentinite) were mentioned previously (1), and on microscopic scale remnants of mafic precursor rocks can be observed in all varieties of impact breccias. For this study, unaltered samples of 4 amphibolite complexes, covering an area of ~0.6 km^2, were taken and analyzed for major and trace element composition using XRF and INAA (Table 1). From geological observations, counting statistics of clasts of impact breccias, and using two-component (gneiss, granite) mixing calculations Lambert (3) found the probable target to have been a mixture of gneiss and granite in proportions somewhere between 50 - 90 % and 5 - 50 %, respectively. To get a better hold on the actual target composition within a 5-component system, we applied the computer program HMX (4,5) to the Rochechouart case using data for target rocks and impact melt from (1,3,7,8, and this work). Results of mixing calculations are given in Table 2. As is discussed by (3), the impact melt composition has been changed severely due to secondary alteration. Therefore, the mixing calculations had to be restricted to only 5 (major element) parameters. Trace element data for rocks other than amphibolite are not available at present. As the compositions of diorite and amphibolite are very similar, 2 sets of calculations deleting either diorite or amphibolite were run in addition to the 5 component calculation. Discrepancy factors of values close to 1 demonstrate the high reliability of the results. We determined a target composition of 66 ±10 % gneiss, <8 % leptynite, 26 ±5 % granite, <5 % amphibolite, and 12 ±5 % diorite. Gneiss and granite proportions are in agreement with the results of (3). However, our work shows that an additional basic component contributed to the impact melt source at a proportion of at least 10 or a maximum of 18 %.

To deduce the maximum indigenous contribution of siderophile elements to the melt composition, we can assume that the dioritic component was similar in composition to the analyzed amphibolites, and certainly did not exceed their contents of siderophile elements. From an INA analysis (courtesy H.Palme, MPI Chemistry, Mainz) of a mixture of 4 amphibolite aliquants it is obvious that the trace element abundances of the Rochechouart amphibolites match very well with a dioritic composition (6). For the above given target composition (with ~15 % basic component) maximum indigenous correction factors of 12.7 ppm Co, 20.8 ppm Ni, ~2.01 ppb Ir, and ~1.8 ppb Au can be determined using trace element data from (7) for gneissic and granitic (orthogneiss, (7)) target. Cr abundances are only determined for the basic component, the 38.3 ppm value of which can be taken as a lower limit for the indigenous Cr correction. Mean corrected Ni/Co and Ni/Ir ratios for impact melt samples analyzed by (7) and (8) are 28.0 ±14 and 36160 ±28700, respectively (due to melt alteration considerable amounts of siderophile elements habe been mobilized! (3)), and support the conclusion of (8) that the Rochechouart crater was produced by a chondritic projectile. Corrected Ni/Cr ratios ($\bar{x}$ = 1.29 ±0.76) lie also closer to chondritic values than those reported by (8).

Pseudotachylite veinlets within impact breccia veins cutting the basement rocks of the Rochechouart crater socle have been described by (1). The cryptocrystalline fillings of these veinlets contain target rock fragments often showing shock effects (e.g. planar elements), and are partially aligned with flow structures of the matrix. Similar pseudotachylite has been found in other impact structures, and also in crystalline rocks of the Vredefort strcture. There is an ongoing discussion as to whether or not the Vredefort pseudotachylite can be associated with an impact event (9,10). We have found a series of pseudotachylite veins of few mm to several cm in width cutting through gneiss between the towns of Saillat and Rochechouart (Fig. 1). The vein fillings are usually altered to mixtures of talc, chlorite, and smectite (Fig. 2), or are hydrothermal deposits of dolomite, calcite, and baryte. Clasts are fragments of the host rock, but do not show any shock features. Where unaltered pseudotachylite is found, it consists of a clear, light-green glass (Fig. 3). Neither flow structures, nucleation centers, nor crystallization products can be detected. Despite the most rapid solidification of the glass, margins of all clasts show resorption or digestion by the surrounding matrix (Figs 3 and 4). This observation is typical for clasts of impact melts, where there is evidently a minimum of time (secs) sufficient to digest part of the clastic debris before the slow cooling process of the melt pool sets off (11). Abundances of siderophile elements are not enriched in pseudotachylite when compared to the siderophile element contents of the Rochechouart basement rocks. Further geological, tectonic, and chemical studies are in process, and results, especially with regard to pseudotachylite genesis, will be reported at a later time.

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References: (1) Lambert, P. (1977) Ph.D. Thesis, Univ. Orsay-Paris; (2) Oskierski, W. (1983) Diploma Thesis, Univ. Münster (in prep.); (3) Lambert, P. (1982) Geol. Soc. Am., Spec. Pap. 190; (4) Stöckelmann, D. and Reimold, W.U. (1982) HMX-mixing calculation program, version May 1982 (to be published); (5) Reimold, W.U. (1982) GCA 46, 1203 - 1225; (6) Handbook of Geochemistry, K.H.Wedepohl (ed.); (7) Janssens, M.-J. et al. (1977) JGR 82, 750 - 758; (8) Palme, H. et al. (1980) Lun. Planet. Sci. XI, 848 - 850; (9) Martini, J.E.J. (1978) Nature 272, 715 - 717; (10) Schreyer, W. and Medenbach, O. (1981) Contrib. Mineral. Petrol. 77, 93 - 100; (11) Onorato, P.I.K. et al. (1978) JGR 83, 2789 - 2798.

Table 1 Major (XRF) and trace element (INAA) composition of Rochechouart amphibolites.

	wt%	2σ		ppm	±
SiO_2	53.60	2.48	Cr	255	3
TiO_2	.95	.61	Co	29.4	3
Al_2O_3	17.41	1.88	Ni	65	20
Fe_2O_3	9.75	1.42	Ir	.002	
MgO	6.44	2.48	Au	.001	
CaO	8.40	1.70			
Na_2O	3.53	.04			
K_2O	.76	.75			

Table 2 Results of mixing calculations with HMX (4)(%)

	gneiss	lept.	gran.	amph.	dior.	DF
run I	62.9±9	0±5	26.8± 5	0±5	10.3±5	1.70
runII	76.4±8	0±4	23.6± 7	0±3	-	1.30
runIII	57.5±10	0±8	29.1±13	-	13.5±8	1.30

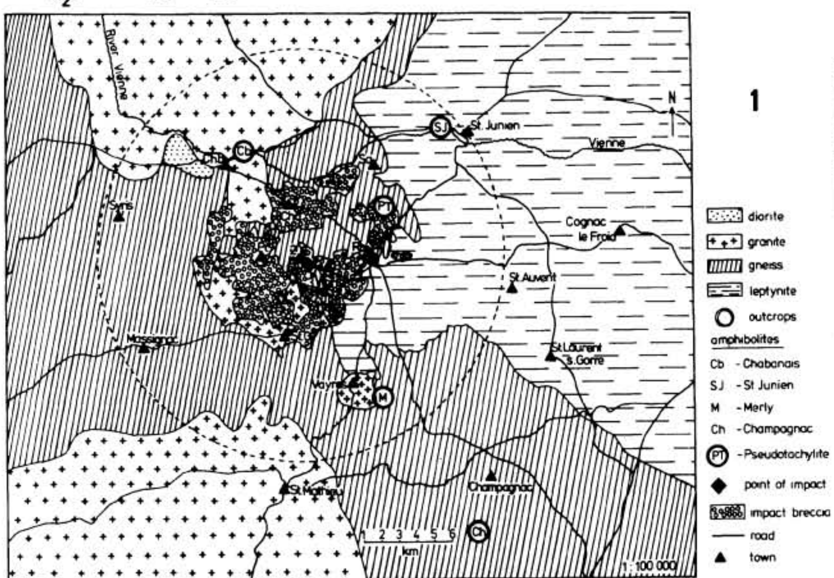
Figure captions:

Fig.1 Geological sketch map of the Rochechouart crater area.

Fig.2 Pseudotachylite altered to clay mineral assemblage.

Fig.3 Clear pseudotachylite glass with host rock fragments.

Fig.4 REM photo of marginally resorbed clast in PT of Fig.3.



Ro - Rochechouart, Ba - Babaudu, Pr - Pressignac, Cha - Chassenon, Chb - Chabanais, Sa - Saillat s Vienne, StG - St Gervais