ALLENDE-AF: UNDISTURBED RECORD OF CONDENSATION, ACCRETION, AND METASOMATISM;G.Kurat (1), H.Palme (2), F.Brandstätter (1),and H.Huth (2);(1) Naturhistorisches Museum, A-1014 Vienna, Austria,(2) Max-Planck-Institut für Chemie, D-65 Mainz, F.R.G.

Allende-AF (All-AF) is an unusual chondritic rock fragment encountered during cutting of a large piece of Allende. In a previous note (1) we reported mainly on its bulk chemical composition which is unusual: the refractory element contents are similar to Allende bulk but some medium volatile (Na, K, Au, As) and volatile (Br, Hg) elements are enriched up to 40x (Au) the Allende bulk.

Macroscopically All-AF resembles a strongly "altered" CV3 chondrite with abundant dark brown rounded objects embedded in a dark matrix. In thinsection these objects are brown, display a variety of accretionary but no magmatic structures and are emedded in an almost opaque matrix. Several types of objects can be distinguished:

Isolated simple structured silicate objects comprise mainly rounded objects (pseudo-chondrules) consisting of subparallel platy olivine (BO structure) with the space between the plates partially filled by nepheline and (rare) sodalite. Less common are angular objects consisting of a network of acicular and blocky olivine with abundant pore space partially filled by nepheline. Accretionary silicate objects consist of randomly aggregated simple objects with porous fillings of blocky olivines or large, bended platy olivine dendrites. Some of these objects contain abundant sulfide-silicate-metal accretionary objects mostly concentrated near or at their surface. These sulfide-silicate-metal objects display a variety of textures and have round to oval and lobate shapes. The most common textural type is a granular intergrowth of silicates with pentlandite, pyrrhotite, and metal, which frequently is covered by a thin rim of sulfides and metal. Less common are accretionary aggregates of concentrically oriented olivine plates and sulfides and metal with sulfide + metal rim. Another less common type consists of dendritic olivine (plus nepheline) partially intergrown and covered by sulfide and metal. Other irregularly shaped objects either consist of a granular mixture of olivine and sulfides or sulfide fills the pore space between platy olivines. Large accretionary objects consist of smaller accretionary silicate objects welded together by dark matrix material. Concentric sulfide-andradite objects with sulfides + metal in the core covered by a coarse-grained granular andradite $\pm$ olivine intergrowth. They are surrounded by a dark matrix consisting of very large (several mm) but thin (5-20 um) bended olivine plates and abundant nepheline. Fine-grained silicate objects within the matrix and some accretionary objects consist of bundles of very fine acicular and dendritic olivines in various orientations with abundant pore space and some nepheline fillings. Only one CAI has been encountered. It has a concentric structure with a core of melilite + spinel (and corundum) covered by an An mantle. Many objects and the ALL-AF fragment itself are partially covered by a discontinuos rim consisting of andradite and hedenbergite. The dark matrix has the same grainsize as the

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transparent objects and also consists mainly of mostly blocky and dendritic olivines. These olivines have submicroscopic inclusions of unknown nature which make them opaque. Part of these inclusions are sulfides.

The major mineralogy of All-AF is simple: It consists mainly of olivine, nepheline, pyrrhotite, pentlandite, andradite, sodalite, uwaruite and little diopside and hedenbergite. There is, however, a variety of rare minerals present(1).The olivines are all rich in FeO (Table, Figure) and are also rich in minor elements. Some olivines (from sulfide-olivine objects) are extremely rich in minor elements, surpassing by far the highest contents reported so far (2,3). The optical properties (uneven extinction, low birefringence) of all ol's suggest a highly defective crystal structure. Remarkable is the presence in almost all silicate objects of Fe-poor cpx which mostly occurs as anhedral grains in between olivines but also sometimes forms the center of large and thin dendritic olivine plates. These cpx's are poor in FeO, and rich in TiO_2 and Al_2O_3 (Table). No low-Ca px is present.

Conclusions: All-AF consists of accretionary objects which formed by agglomeration of mainly olivine condensates and which were welded together by condensates which preferentially condensed within the cooler intersticies of the aggregates according of the mechanism proposed by (4). These aggregates escaped the heating event experienced by almost all objects present in normal Allende. They therefore represent protoliths for chondrules, many of which resemble the common armoured chondrules and BO chondrules of C3 chondrites but without having experienced recrystallization, partial or total melting. However, these objects and the total All-AF rock did not escape severe metasomatism. By an exchange reaction between the ambient gas and the originally Fe-free silicates Fe^{2+} and Mn^{2+} were exchanged for Mg^{2+} in olivines, but not in cpx. During this reaction condensation proceded, filling voids with olivine + nepheline and precipitating andradite and hedenbergite at the surfaces. As a result All-AF is a well compacted and almost "equlibrated" carbonaceous chondrite.

References: (1) Palme,H.et al.(1985), LPS XVI, 645- (2) Hoinkes,G. and Kurat (1975), Meteoritics 19, 416. (3) Steele,I.M.(1986) GCA 50, 1379. (4) Arrhenius,G. and B.R.De (1973), Meteoritics 8, 297.

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Table : Selected mineral compositions from All-AF (in weight-%).

	1	2	3	4	5	6	7	8	9
SiO_2	37.4	37.5	34.8	35.8	35.3	54.0	35.1	35.6	35.5
TiO_2	0.10	0.04	0.25	0.06	0.15	0.94	0.05	0.05	10.2
Al_2O_3	1.20	0.73	2.90	2.67	1.44	3.7	0.96	1.27	20.0
Cr_2O_3	0.22	0.21	2.60	2.11	0.50	0.76	-	-	0.07
Fe_2O_3	-	-	-	-	-	-	-	28.0	-
FeO	22.6	26.0	23.8	24.2	35.8	1.49	38.7	1.15	2.29
MnO	0.20	0.21	0.12	0.21	0.22	0.22	0.18	-	-
NiO	0.07	0.13	0.23	0.42	0.18	0.07	0.02	-	-
MgO	37.3	35.0	32.1	34.4	27.2	19.4	23.9	0.03	7.4
CaO	0.21	0.14	0.66	0.33	0.21	20.9	0.24	32.3	24.7
Na_2O	0.08	-	0.37	0.12	0.17	0.06	0.14	-	0.08
Total	99.38	99.96	97.93	100.32	101.17	101.54	99.29	98.40	100.24

1: Ol, coarse-grained BO in object 9, center. 2: Ol, platy, off center, object 9. 3: Ol, granular silicate+sulfide object within 9.4: Ol, inside sulfide+awaruite ring within object 9. 5: Ol, blocky aggregate within object 5. 6: Cpx, coexisting with Ol #5. 7: Ol, andradite+sulfide object 3. 8: Andradite coexisting with sulfide+ol #7. 9: Cpx coexisting with andradite, object 3.

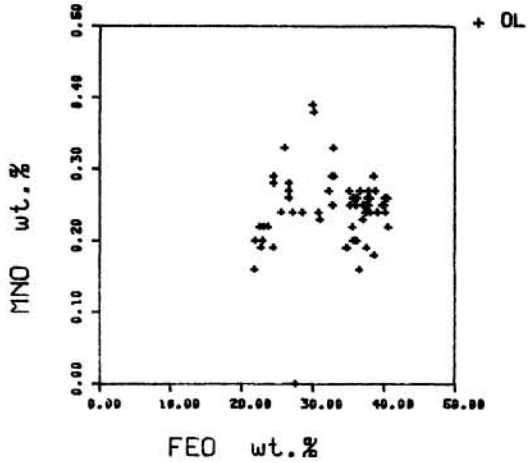

Fig.: Ol compositions in All-AF