^{26}Al-^{26}Mg ISOTOPE SYSTEMATICS IN LEOVILLE CAIs AND CHAINPUR CHONDRULE. R. K. Mishra[1], K. K. Marhas[2] and M. Trieloff[1], Institut fur Geowissenchaften, Klaus-Tschira-Labor für Kosmochemie, Im Neuenheimer Feld 234-236 Ruprecht-Karls-Universität, Heidelberg, D 69210 Germany email: riteshkumarmishra@gmail.com [2]Physical Research Laboratory, Navrangpura, Ahmedabad Gujarat India 380009.

Introduction: The short-lived now extinct radionuclide- ^{26}Al decays to ^{26}Mg with a half-life of 0.72 Ma. Aluminium and magnesium are major components of several phases (spinel, melilite, anorthite etc.) of early Solar System solids, Ca-Al-rich inclusions (CAIs) and chondrules, and the ^{26}Al-^{26}Mg relative chronometer is widely used to decipher events and processes in the early Solar System [1-10]. Here we report results from ^{26}Al-^{26}Mg isotope systematics in CAIs from Leoville and an Al-rich chondrule from Chainpur.

Petrography and Mineralogy: (a) Leoville CV_{red} 3.1: Leoville, a find (1961, Decatur, Kansas; ~8.1 kg), belongs to the reduced carbonaceous chondrites of Vigarano type and is petrographically classified as 3.1. Abundances of pre solar grains, noble gases, distribution, composition of metal grains, sulphides and petrographic and mineralogical studies of CAIs and chondrules provide evidences of both preservation of pristine characteristics and alteration within different components of Leoville. The presence of large, pristine CAIs led to selection of Leoville for this study, in which we analysed one type A and one type B CAI. Leoville CAI 1 is a large ovoid shaped type B2 CAI of ~2.5×2.5 cm size (Fig. 1). Spinel, anorthite, pyroxene, melilite are major mineral phases. Ti-rich pyroxenes are mostly zoned as are several melilites which are less akermanitic at grain boundaries. Anhedral spinels of varying sizes are mostly hosted within or in association with pyroxene. A Wark-Lovering rim of ~100 µm width surrounds one half of the exposed perimeter; the other half is a broken fragmental remain. The Wark-Lovering rim is composed of spinel, hibonite, anorthite, pyroxene, and olivine rims sequentially ordered from inside to outside. Leoville CAI 3 is an irregularly shaped melilite rich compact type A CAI of ~500 µm. Several nodules having similar morphological and mineralogical characteristics but of varying sizes seem sintered to constitute this CAI. Typically, a nodule consists of a melilite core surrounded by a thin rind of anorthite, enveloped by a thicker outermost pyroxene layer. A few nodules have spinel, in one particular case a large grain (~30 µm), in the core of a nodule. A few cross cutting Fe-veins of varying thickness pass through the CAI. Regions around the veins are distinctly enriched in Al. (b) **Chainpur LL3.4:** Chainpur, a fall (1907, India; 8.2 kg), belongs to ordinary chondrites of LL type and is classified as petrographic type 3.4. The Al-rich chondrule from Chainpur is ~200 µm in diameter. It is composed of plagioclase, pyroxene, olivine, and Fe-Ni metal. The outer boundary of the chondrule is fractured, broken, uneven remains of the grains, unlike the typical distinct circular boundary seen in chondrules. Two large (~50-100µm) metal (Fe, Ni, Cr, P) nodules are also present along with a few Fe-Ni veins cross cutting the chondrule.

Analytical Procedure: ^{26}Al-^{26}Mg isotope systematics were carried out in mono-collection mode using the secondary ion mass spectrometer CAMECA 1280 HR2 at Heidelberg university. A focused primary O^- beam of 20µm size of ~0.5 nA was used to sputter secondary positive ions of ^{24}Mg, ^{25}Mg, ^{26}Mg, and ^{27}Al. The secondary ions accelerated by 13kV were energy sorted by the electrostatic sector before passing through the magnetic sector. An energy window of 50 eV was used. Dead time corrections were applied to measured count rates. Sum of counts were used to calculate isotopic ratios. Several terrestrial standards (Burma spinel, San Carlos olivine, MORB glasses) and synthetic glasses (Åk 20, Ca-Px, anorthite) analogous to mineral phases in CAIs encompassing a range of abundance of Al, Mg and Al/Mg ratios were used for calibration and obtaining relative sensitivity factors.

Results and Discussion: Analysis of melilite and anorthite in Leoville CAI 1 show mass fractionation corrected excesses in ^{26}Mg/^{24}Mg up to ~70 permil (Fig. 2). The observed excesses in ^{26}Mg/^{24}Mg correlate with ^{27}Al/^{24}Mg and yield an isochron with initial ^{26}Al/^{27}Al of $(4.84\pm0.32)\times10^{-5}$. Analysis of melilite in CAI 3 yielded a limited range in ^{27}Al/^{24}Mg of <8 while analyses of plagioclase in the Chainpur chondrule showed a larger range of up to 35. The ^{26}Al/^{27}Al of Leoville CAI 1 implies its formation at ~0.09±0.02 Ma after the formation of Solar System if anchored to the canonical abundance of ^{26}Al/^{27}Al of 5.25×10^{-5} [7]. The observed abundance of ^{26}Al/^{27}Al is typical for type B CAIs consistent with previous observations including a few studies from Leoville [3-7]. Melilite analysed in Leoville CAI 3 yield small excesses of up to 5 permil rather independent of ^{27}Al/^{24}Mg. A regression through the data yields a value of ^{26}Al/^{27}Al of $(-2.2\pm2.0)\times10^{-5}$, i.e. no resolvable contribution by in situ ^{26}Al decay. Although, analyses were made in regions devoid of any obvious signs of alteration, the ^{26}Al records suggests mobilization, diffusion or mixing of Mg and/or Al between the phases. Textural features, Fe-Ni veins, and relative enrichment in Al around the Fe-rich veins lend support to the observed isotopic records. Chainpur Ch1 also show evidence of disturbed Mg isotopic records. Despite a relative large range of $^{27}Al/^{24}Mg$ in plagioclase in the chondrule, no isochron indicating in situ ^{26}Al decay could be obtained, consistent with the petrography.

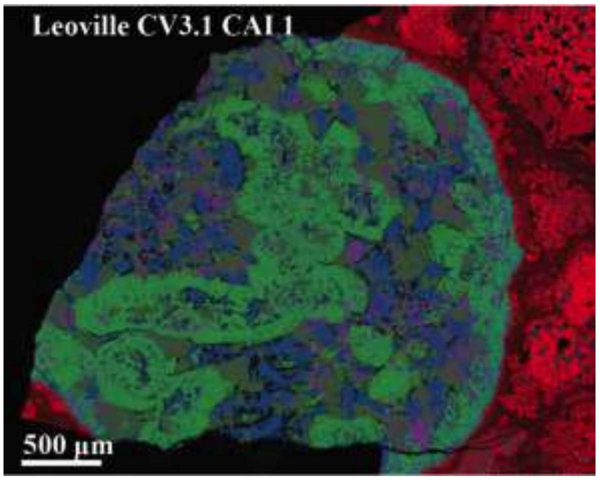
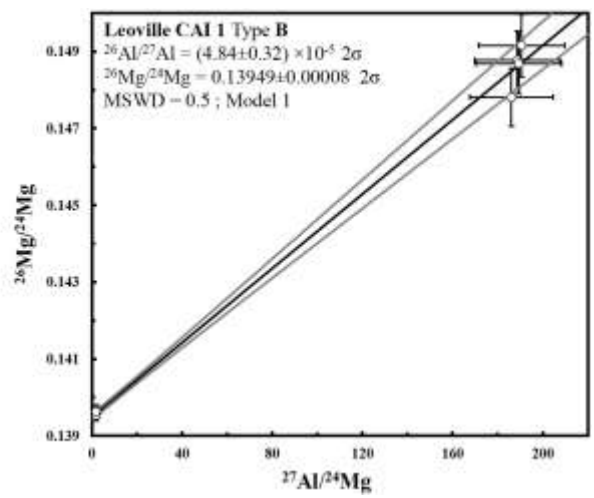


Fig. 1. X-ray elemental mosaic image of a type B2 Leoville CAI 1. Abundance of Mg, Ca, Al are shown by red-green-blue colours.



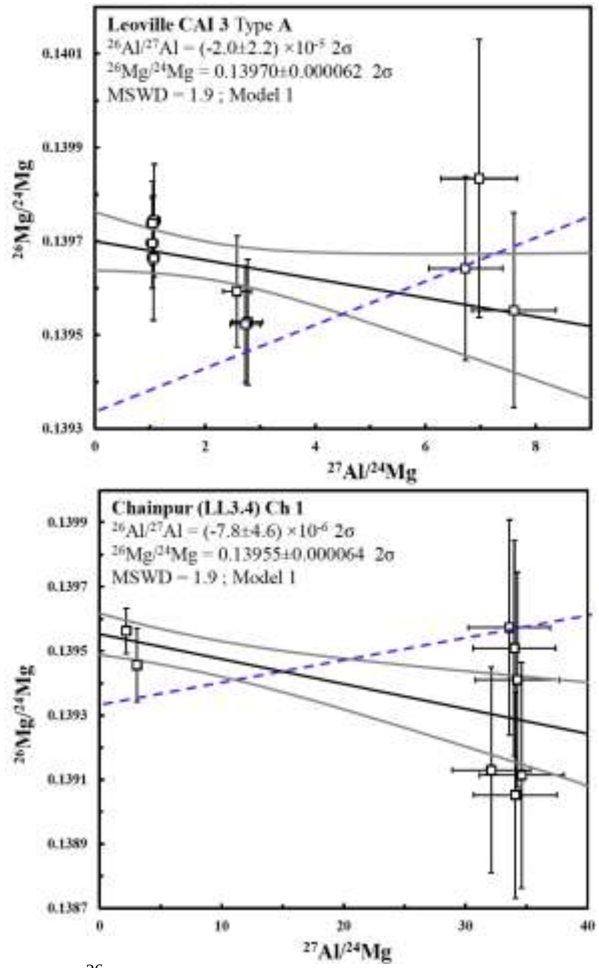


Fig. 2. ^{26}Al isochron plots for Leoville CAI 1, CAI 3 and Chainpur Chondrule 1. Error bars are 2σ. The blue lines in isochron plots of CAI 3 and Ch 1 show the typical $^{26}Al/^{27}Al$ abundances corresponding to 5.25×10^{-5} and 1×10^{-5} usually observed in CAIs and chondrules.

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