

# Combined multi-isotopic and (S)TEM study of pre-solar silicates to probe the solar system's prenatal history

L Lajaunie<sup>1</sup>, MN Sanghani<sup>2</sup>, WDA Rickard<sup>3</sup>, S Sung-Yun Hsiao<sup>4</sup>, Z Peeters<sup>4</sup>, H Shang<sup>4</sup>, Der-Chuen Lee<sup>4,5</sup>, JJ Calvin<sup>1</sup>, KK Marhas,<sup>6</sup> M Bizzarro<sup>2</sup>



<sup>1</sup>*Departamento de Ciencia de los Materiales e Ingeniería Metalúrgica y Química Inorgánica, Universidad de Cádiz, Spain*

<sup>2</sup>*StarPlan – Centre for Star and Planet Formation, University of Copenhagen,, Denmark*

<sup>3</sup>*John de Laeter Centre, Faculty of Science and Engineering, Curtin University, Australia*

<sup>4</sup>*NanoSIMS Laboratory, Institute of Astronomy and Astrophysics, Academia Sinica, Taipei, Taiwan ROC*

<sup>5</sup>*Institute of Earth Sciences, Academia Sinica, Taipei, Taiwan ROC*

<sup>6</sup>*Physical Research Laboratory, Navrangpura, Ahmedabad, India*

# Highlights

- We studied nine presolar silicate grains from the CH3/CBb3 chondrite Isheyevo and from the CR2 chondrite NWA801.
- We correlated multi-isotopic data of individual presolar silicates with advanced (S)TEM analyses.
- (S)TEM data includes structural data (HR-STEM, HR-TEM and electron diffraction), quantitative analysis (EDS and EELS) and determination of Fe and O local chemical environments (EELS analysis of Fe-L<sub>23</sub> and O-K edges).
- We highlighted a strong heterogeneity and a broad range of structural and chemical compositions of the grains that enabled us to compare the stellar grain condensation environments (e.g. asymptotic giant branch (AGB) stars and ejecta of supernovae (Sne)).

# Experimental (1/2)

- Presolar oxygen anomalous grain search using oxygen isotope imaging was done in-situ using NanoSIMS50 ion microprobe.
- The TEM lamellas were prepared using a TESCAN LYRA3 FIB-SEM at Curtin University (Australia).
- Advanced (S)TEM analyses were performed by using a FEI Titan Cubed Themis 60-300 microscope at the University of Cádiz (Spain) which was operated at 200 kV.

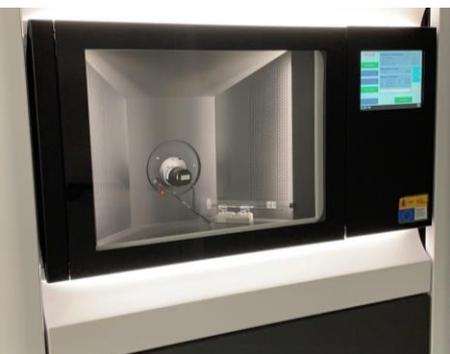
# Experimental (2/2): (S)TEM

- EDS quantification was corrected by using a standard reference sample of known composition and density and by taking into account the thickness of the probed area by using low-loss EELS => **quantification of light elements including Oxygen.**
- EELS spectrum images for fine structures analyses (mostly, O-K, Si-L2,3 and Fe-L2,3 edges) were acquired with the monochromator excited allowing an energy resolution of about 0.4 eV.
- EELS mapping of the Fe oxidation state and of the oxygen local chemical environment => **comparison of the degree of aqueous alteration of the grain with the surrounding rim and matrix grains.**

# Electron Microscopy Facilities at the University of Cádiz (Spain)



- **Ultra High Resolution TEM/STEM FEI Cubed Titan Themis 60-300.** Aligned at 60, 80, 200 and 300 kV. Super EDS X detector, which consists of a 4-windowless detector that can be used independently, and Ultra High Resolution EELS Energy Filter (Gatan Quantum ERS) which allows working in Dual-EELS mode (Core Loss/Low Loss) ...



- **High Resolution TEM/STEM FEI Talos F200X (80 and 200 kV).** X-FEG electron gun and a high efficiency, high sensitivity Super X-EDS detector, 4 STEM detectors...
- Sample preparation facilities, environmental and tomographic sample-holders, large variety of hardware and specially software for data analysis ...

# New collaborations

- Strong experiences of our team in TEM analyses of carbon-based materials and inorganic materials, EDS and EELS spectroscopic analyses, imaging and tomography ...
- We are part of ESTEEM3, a European network which provides transnational access to our facilities and pay for microscope time and some travel expenses.
- We are **always interested in new collaborations**. Do not hesitate to contact us: [luc.lajaunie@uca.es](mailto:luc.lajaunie@uca.es)



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