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Deliverable 9.3 - Publications on: 10^13 Ohm resistors

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Responsible WP Leader: Vrije Universiteit, Professor Gareth R. Davies, Natural History Museum, Professor Sara Russell

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Dissemination level		
PU	Public	X
PP	Restricted to other programme participants (including the Commission Service)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (excluding the Commission Services)	

Project Number	654208
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Title of Deliverable	Publications on: 10^13 Ohm resistors
Contributing Work package (s)	WP9 (JRA 3)
Dissemination level	Public
Author (s)	Gareth Davies, Sara Russell

Abstract: The overall task is to undertake a rigorous evaluation of the performance of 10^{12} and 10^{13} Ohm resistors in different instrument types particularly focusing on ion currents in the >5000 to < 100000 counts per second where secondary electron multipliers (SEM's) suffer from the greatest non-linearity. The potential benefits of the widespread introduction of this ground breaking technology offers the possibility of opening new frontiers across the spectrum of analytical chemistry finding applications wherever sample size is a key limiting factor, such as in sample return missions and the study of extra-terrestrial material (e.g., meteorites).
To date there has been one publication and two are in press; all in high to very high impact journals in their fields. A series of presentations made at recent international conferences suggests that the JRA has been extremely successful and that further high impact publications can be expected over the next few years.

Overview of JRA goals:

WP9-JRA3: involves four institutions with the remit to optimise planetary sample handling, investigation and analysis. The specific goal of D9.3 is to minimise the amount of sample required for isotopic analysis. To this end collaborations/non-disclosure agreements were set up with leading instrument manufacturers (ThermoFisher and CAMECA) to improve the sensitivity of ion detection systems. The overall task was to undertake a rigorous evaluation of the performance of 10^{12} and 10^{13} Ohm resistors in different instrument types particularly focusing on ion currents in the >5000 to < 100000 counts per second where secondary electron multipliers (SEM's) suffer from the greatest non-linearity. The potential benefits of the widespread introduction of this ground breaking technology offers the possibility of opening new frontiers across the spectrum of analytical chemistry finding applications wherever sample size is a key limiting factor, such as in sample return missions and the study of extra-terrestrial material (e.g., meteorites) as well as in archaeology, forensics and art history.

Work successfully undertaken:

Newly developed detection systems have been installed in instruments at VUA and CNRS-CRPG Nancy. At VUA, 10^{13} Ohm resistors were evaluated in positive ion mode on thermal ionisation and multi-collector mass spectrometers. At Nancy 10^{13} Ohm resistors were evaluated in negative ion mode on a thermal ionisation mass spectrometer and 10^{12} Ohm on a secondary ionisation mass spectrometer. This latter work involved a close collaboration between OU and CRPG and included visits to CAMECA's factory in Paris. Performance of both new types of amplifier systems yielded close to the theoretical prediction, i.e. close to a factor of 10 improvement in signal to noise for the 10^{13} Ohm system allowing significantly smaller sample sizes to be analysed.

Dissemination-Publications:

To date there has been one publication (Timmerman et al., 2017) and two are in press, (Koornneef et al., 2017a; Knaf et al., 2017) all in high to very high impact journals in their specific field. The Europlanet NA2 team helped formulate a press release based on the Timmerman et al. publication. This resulted in significant press interest as detailed in the periodic report. A series of presentations have been made at recent international conferences (e.g., Reisberg et al., 2017; Koornneef et al., 2017b) suggesting that the JRA has been extremely successful and that further high impact publications can be expected over the next few years. Significantly the work has had impact outside planetary and Earth sciences with recognition that the technique has great potential for "non-destructive" analysis of archaeological and art objects (Knaf et al., 2017).

Knaf, A.C.S., Koornneef, J.M. & Davies, G.R. (2017). "Non-invasive" portable laser ablation sampling of art and archaeological materials with subsequent Sr - Nd isotope analysis by TIMS using 10^{13} Ω amplifiers. Journal of Analytical Atomic

Spectrometry, published by the Royal Society of Chemistry. Accepted, awaiting proofs.

Koornneef, J.M., Gress, M.U., Chinn, I.L., Jelsma, H.A., Harris, J.W. & Davies, G.R. (2017a). Archaean and Proterozoic diamond growth from contrasting styles of large-scale magmatism beneath Venetia South Africa. Nature Communications. DOI: 10.1038/s41467-017-00564-x. proofs returned.

Koornneef, J.M., Nikigosian, I., van Bergen, M., Vroon, P.Z., & Davies, G.R. (2017b). Ancient recycled lower crust trapped in deep magmatic olivine from Italy: Evidence from Sr-Nd-Pb isotopes in melt inclusions from Roccamonfina Ernici. Goldschmidt Abstract.; https://whiteiron.org/uploads/conferences/27/abstracts/finalPDFs/2017001692-20170323095629.pdf

Reisberg L, Zimmermann C & Caro G. 2017. Analysis of $^{186}Os/^{188}Os$ Ratios by NTIMS Using Amplifiers Equipped with 10^{13} ohm Resistors. Goldschmidt Abstract.; https://whiteiron.org/uploads/conferences/27/abstracts/finalPDFs/2017005535-20170401075452.pdf

Timmerman, S., Koornneef, J.M., Chinn, I.L. & Davies, G.R. (2017). Dated diamond growth zones reveal variable recycling of crustal carbon through time. Earth and Planetary Science Letters, 463, 178-188.