

Development and validation of a novel experimental system for physical characterisation of particulate matter

M. Barker*¹, C.W. McLeod¹, D. Ciaparra², K. Jackson² & D.R. Anderson²

¹ Centre of Analytical Sciences, University of Sheffield, S3 7HF, UK

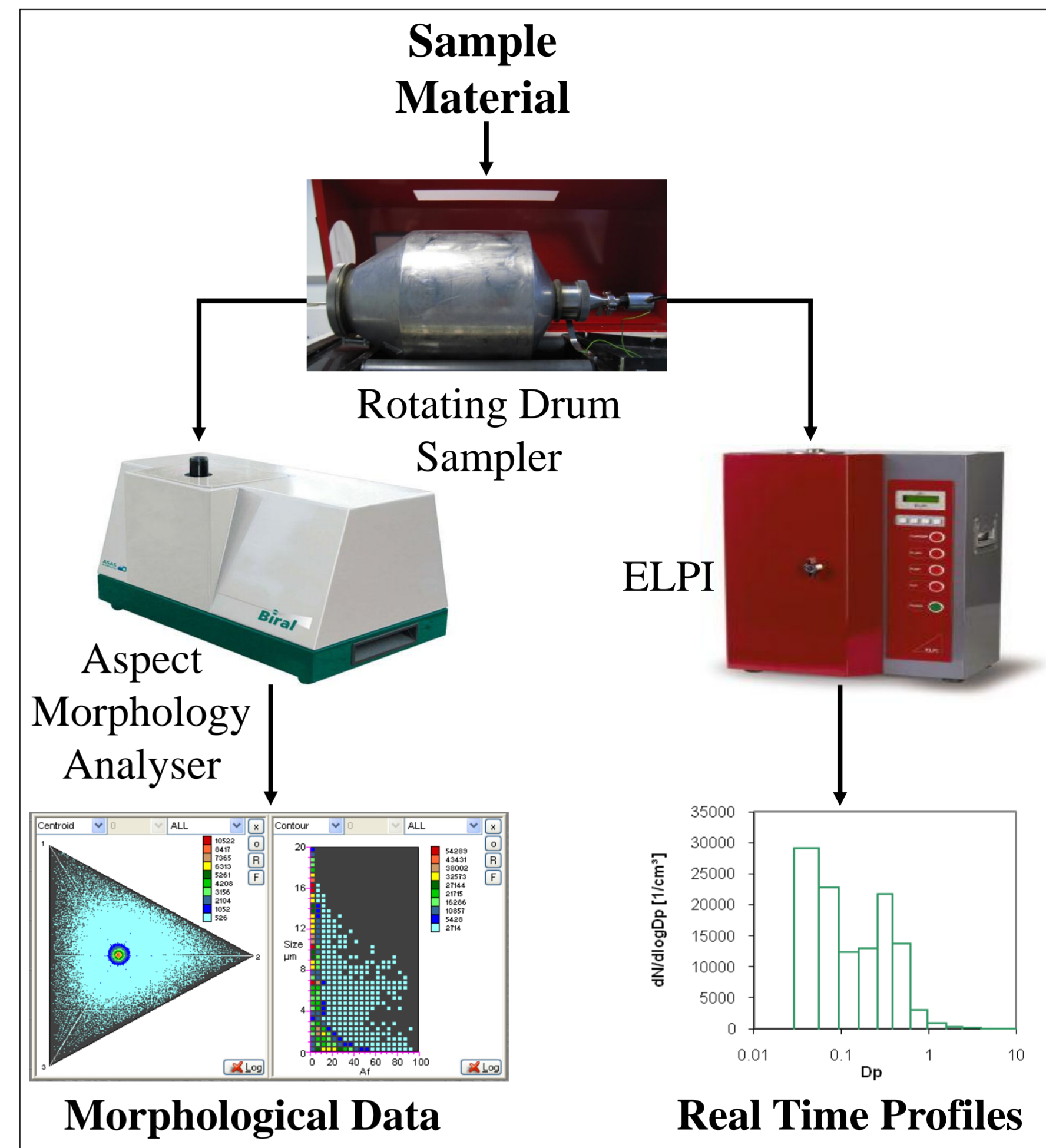
² Group Environment, Tata Steel Europe, Swinden Technology Centre, Rotherham, S60 3AR, UK

1. Introduction

Workplace exposure to particulate matter (PM) can be a health risk, especially if it is able to penetrate into the respiratory system (Petavratzi *et al.*, 2005). Both the shape and size of PM determines how far along the respiratory tract it can penetrate and also its rate of removal. One known source of PM within the iron and steel making industry is the handling and stockpiling of raw materials. To help further understand such sources of PM and develop abatement procedures, full characterisation must be completed.

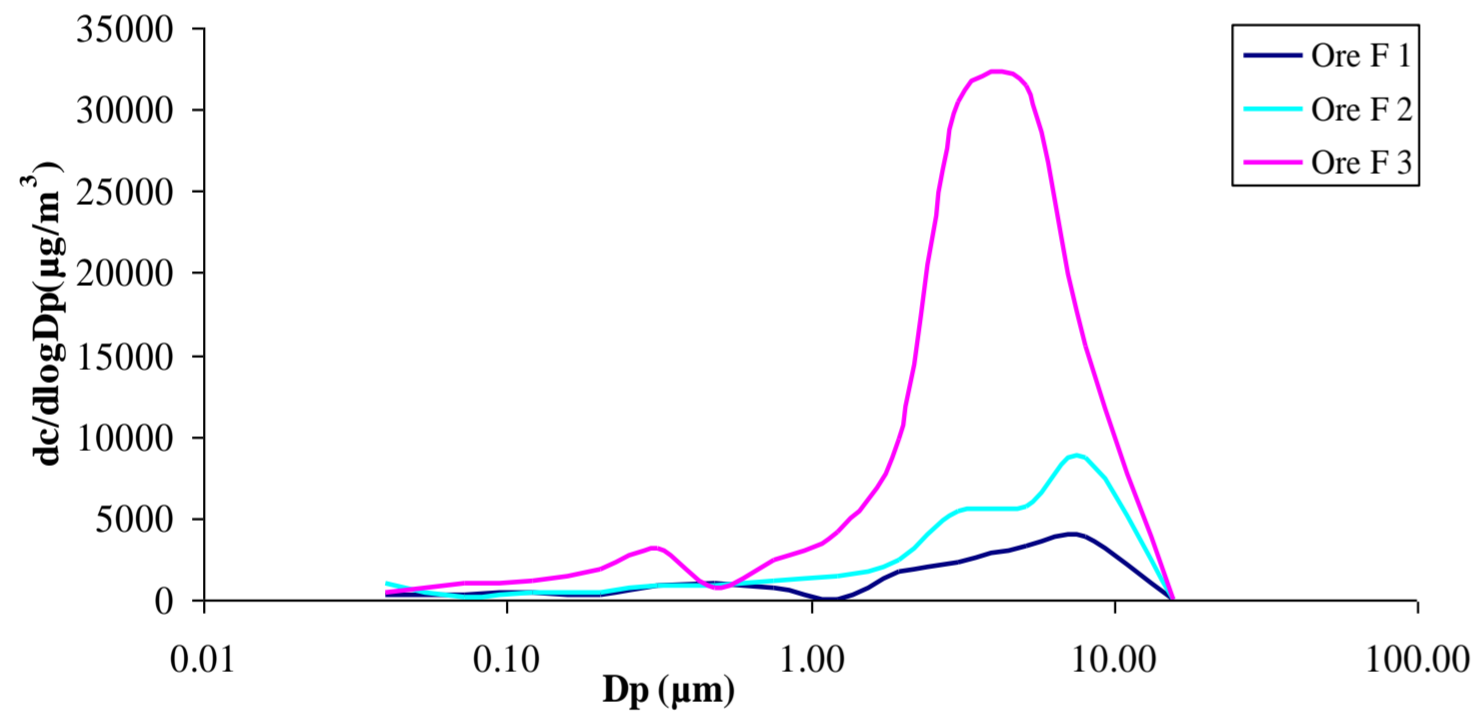
2. Methodology

An Aspect morphology analyser and an ELPI have been coupled, both individually and simultaneously, to a rotating drum sampler (RDS). This unique set up allows the determination of real time morphological information for particulates 0.5 μm to 20 μm in diameter and number and mass size distributions for particulates 30 nm to 20 μm in diameter. Four granular samples, two Brazilian iron ores, a blast furnace flue dust and a sinter dust, originating from an integrated steelworks have been tested. Two replicates were completed for each sample with three instrument conformations, i.e. ELPI-RDS, Aspect-RDS and ELPI-Aspect-RDS. Each run lasted four minutes and 16 rotations of the drum were completed in this time. Poreless polycarbonate substrates (25 mm) were used within the ELPI.

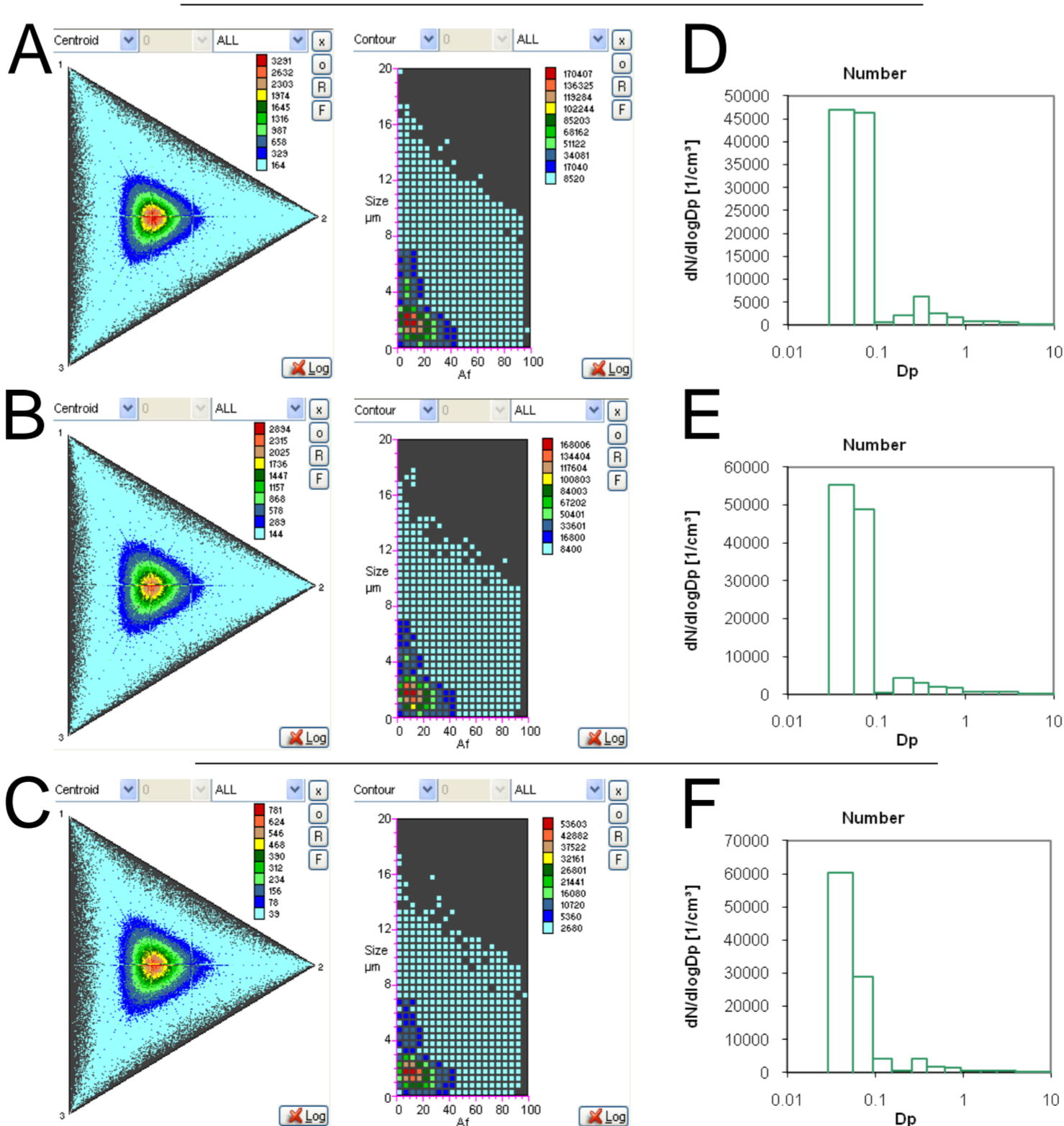
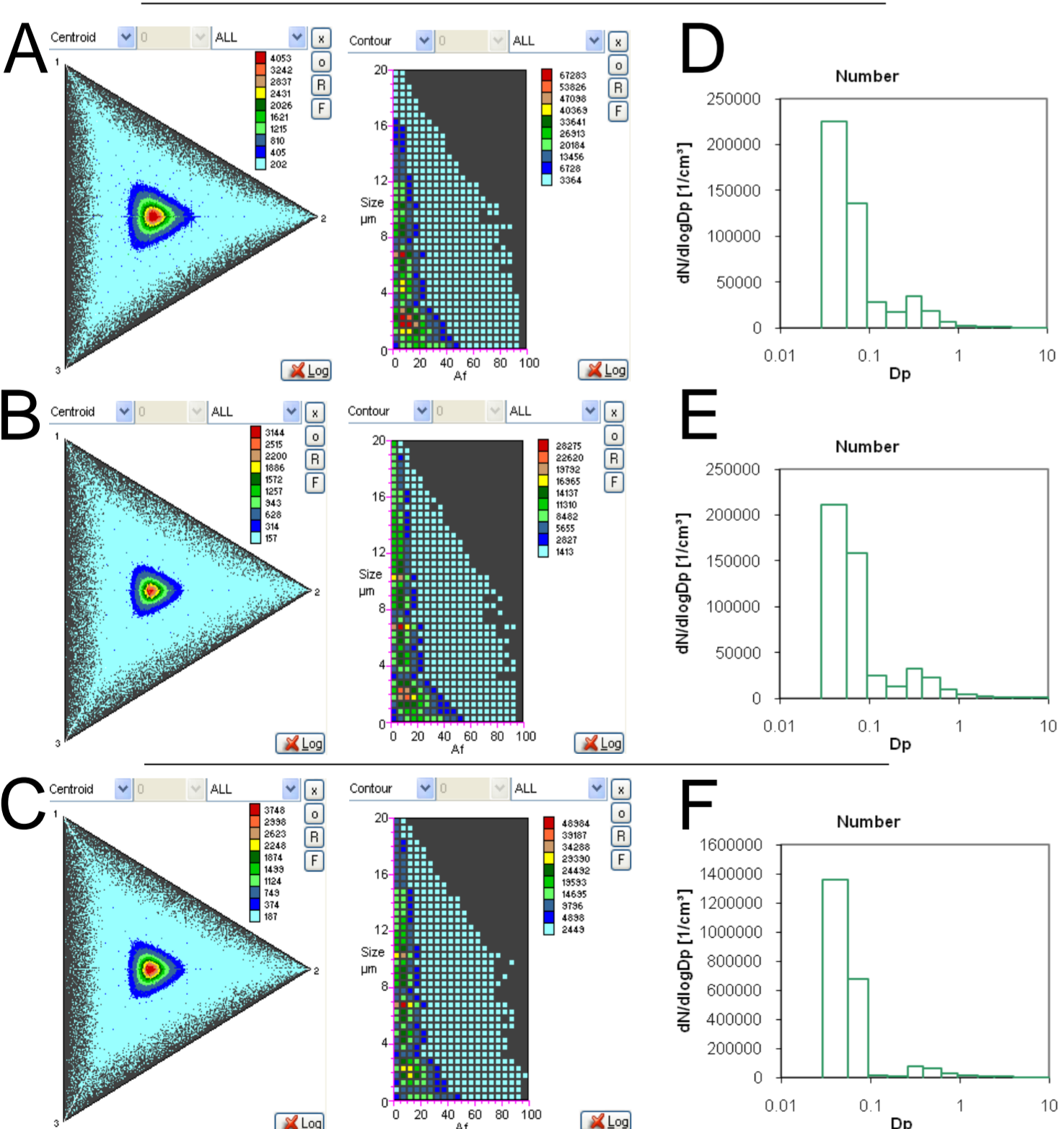
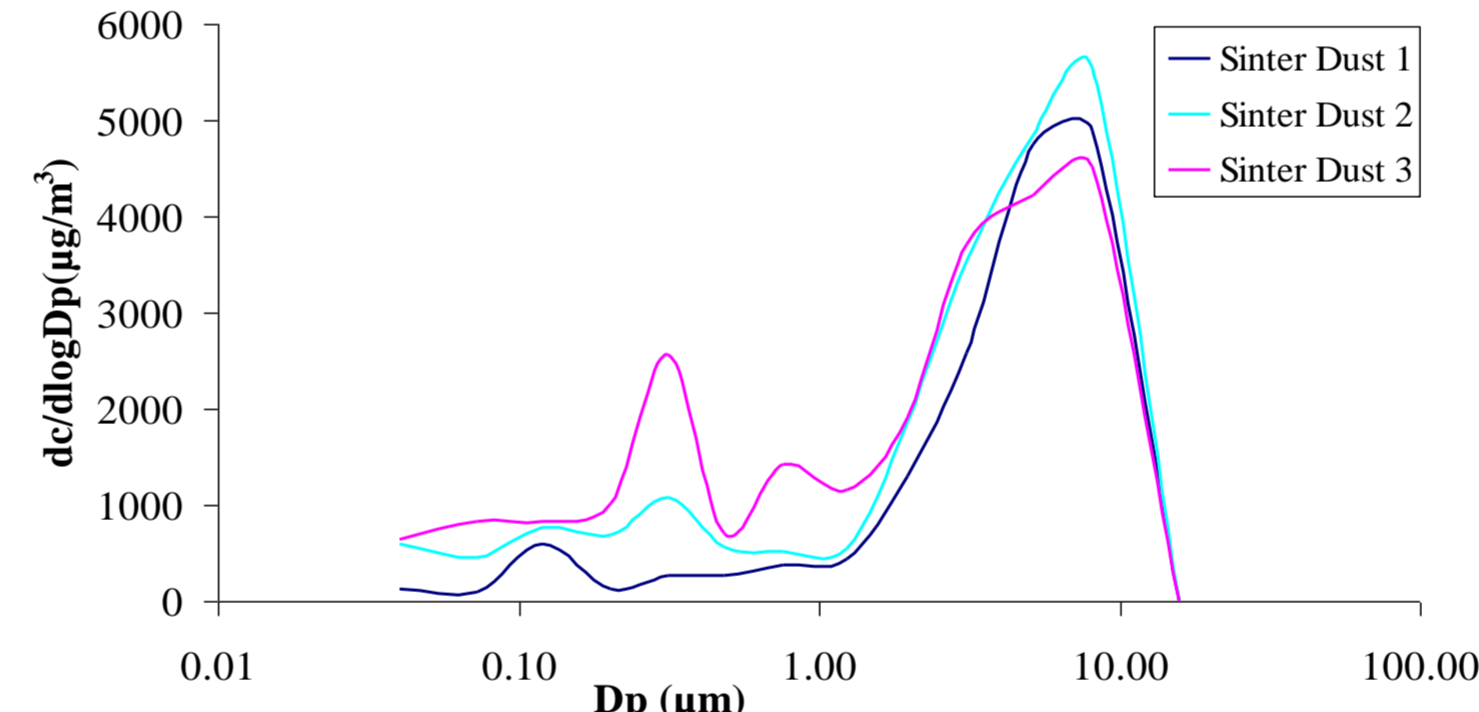


3. Results and Discussion

Ore F Results



Sinter Dust Results



- Mass size distributions (top) show a large mass of PM c.a. 10 μm
- runs 1 & 2 were carried out by ELPI-RDS and run 3 by ELPI-Aspect-RDS
- Aspect morphological profiles (A,B,C)
- profiles A and B, were from Aspect-RDS tests, profile C, was from ELPI-Aspect-RDS tests
- Ore F: Mainly spherical PM with some causing irregular light scattering. High concentrations of PM at 3, 7, & 10 μm .
- Sinter Dust: Light scattered irregularly, by flat faces on PM, suggesting asymmetry. High concentration of PM between 1 and 3 μm .
- ELPI number distributions (D,E,F) show a prominent peak for PM at c.a. 0.05 μm
- number distributions D and E, were from ELPI-RDS tests, distribution F, was from ELPI-Aspect-RDS tests

4. Conclusions

Both instruments have been successfully coupled to the RDS, however if coupled simultaneously (ELPI-Aspect-RDS) changes in concentrations could be seen. Materials showed some similarities in their shape but had very different size distributions. Replicates produced similar profiles. As part of further work a mix of materials will be tested to determine whether individual material characteristics are retained.

5. References

Petavratzi, E., Kingman, S., Lowndes, I.(2005) *Minerals Engineering*, **18**, 1188-1199

6. Acknowledgements

EPSRC, Tata Steel and the RFCS, grant number RFSR-CT-2009-00029, for funding