Geophysical Research Abstracts
Vol. 18, EGU2016-4325, 2016
EGU General Assembly 2016

Spreading dynamic of viscous volcanic ash in stimulated jet engine conditions

wenjia song (1), Yan Lavallée (2), Kai-Uwe Hess (1), Ulrich Kueppers (1), and Corrado Cimarelli (1)

(1) Department of Earth and Environmental Sciences, Ludwig-Maximilians-Universitaet (LMU) Munich, Germany (wenjia.song@lmu.de), (2) Department of Earth, Ocean and Ecological Sciences, University of Liverpool, Liverpool L69 3GP, UK

The ingestion of volcanic ash is widely recognised as a potentially fatal hazard for aircraft operation. The volcanic ash deposition process in a jet turbine is potentially complex. Volcanic ash in the air stream enters the inner liners of the combustors and partially or completely melts under the flames up to 2000 °C, at which point part of the ash deposits in the combustor fuel nozzle. Molten volcanic particles within high energy airflow escape the combustor to enter the turbine and impact the stationary (e.g., inlet nozzle guide vanes) and rotating airfoils (e.g., first stage high-pressure turbine blades) at high speed (up to Mach 1.25) in different directions, with the result that ash may stick, flow and remain liquid or solidify. Thus, the wetting behaviour of molten volcanic ash particle is fundamental to investigate impingement phenomena of ash droplet on the surface of real jet engine operation. The topic of wetting has received tremendous interest from both fundamental and applied points of view. However, due to the interdisciplinary gap between jet engine engineering and geology science, explicit investigation of wetting behaviour of volcanic ash at high temperature is in its infancy. We have taken a big step towards meeting this challenge. Here, we experimentally and theoretically investigate the wetting behaviour of viscous volcanic ash over a wide temperature range from 1100 to 1550 °C using an improved sessile-drop method. The results of our experiment demonstrate that temperature and viscosity play a critical role in determining the wetting possibility and governing the spreading kinetics of volcanic ash at high temperatures. Our systemic analysis of spreading of molten volcanic ash systems allows us to report on the fundamental differences between the mechanisms controlling spreading of organic liquids at room temperature and molten volcanic ash droplets.