Smoke source strength from satellite measurements of fire strength

CHARLES ICHOKU[1], MIAN CHIN[1], THOMAS DIEHL[1,2] AND QIAN TAN[1,2]

[1]Laboratory for Atmospheres, NASA/GSFC, Greenbelt, MD 20771, USA
[2]GEST, University of Maryland, Baltimore County, MD, USA

Chemical transport models currently derive their smoke emission sources from counts of fire hot spots detected from satellites, usually with single daily overpasses. However, fires vary in size and strength, with prominent diurnal cycles that vary from one biome to another, making the use of pixel counts measured at the same time of day very unreliable for estimating smoke sources. Fortunately, the Moderate-resolution Imaging Spectro-radiometer (MODIS) twin sensors onboard the Terra and Aqua satellites, not only detect fires everywhere at four strategic times of day, but also measure their strength in the form of fire radiative power (FRP) or rate of release of fire radiative energy (FRE). FRP is now also being derived from the Spinning Enhanced Visible and Infrared Imager (SEVIRI) sensor onboard the geostationary Meteosat-8 platform, which observes Africa and Europe virtually every 15 mins. The SEVIRI measurements show that MODIS 4-times-a-day measurements capture the essence of the fire diurnal cycle. Therefore, MODIS is currently the only satellite data source ideal for estimating daily smoke emissions globally. Although MODIS has been in operation since the last 9 years, regrettably, this rare but formidable data resource it provides (FRP) has remained largely underutilized. However, in a number of recent studies, FRP has been found to be directly proportional to both the rate of biomass consumption and the rate of smoke aerosol emission. Indeed, a FRE-based emission coefficient (Ce), which is a simple coefficient to convert FRP (or FRE) to smoke aerosol emissions was derived for different parts of the world. The results obtained from satellite have been reproduced in the laboratory, and the ingestion of FRP in models is now being tested using the Goddard Chemistry Aerosol Radiation and Transport (GOCART) model. In this presentation, we will show the preliminary results of using FRP to improve the smoke emission source characterization and impacts analysis.

Two-stage growth evolution of hydrothermal quartz: Impurities quantify the story

P.D. IHINGER[1]*, D.J. KAWATSKI[1], D.J. STELTZ[1], AND R.L. HERVIG[2]

[1]University of Wisconsin-Eau Claire, Eau Claire, WI 54701, USA (*correspondence: 7ihinger@uwec.edu) (kawatsdj@uwec.edu, steltzdj@uwec.edu)
[2]Arizona State University, Tempe, AZ 85287, USA (hervig@asu.edu)

Large-scale hydrothermal fluid systems control the thermal evolution of the Earth's crust. Quartz crystals, the primary product of circulating aqueous fluids, contain fluid inclusions and chemical impurities that document their growth history in hydrous environments [1, 2]. High-resolution FTIR measurements show that natural quartz crystals are composed of sector zones characterized by distinct concentrations of hydrous impurities. Some hydrothermal environments (e.g., Minas Geras, Brazil) produce crystals that document a single phase of growth characterized by growth on only the six terminal rhombohedral faces [1]. Here, we document the distribution of defect abundances in several crystals extracted from a single vug from Le Chang City, Guangdong Province, China that record two distinct phases of growth. Each crystal contains: (1) an inner core, with elevated AlOH concentrations (50-200 ppm), intermediate LiOH and HOH concentrations (10-100 ppm) and negligible KOH concentrations (< 5 ppm); and (2) a thick outer rim with LiOH and HOH > AlOH, and KOH > 5 ppm. Rim thickness remains constant up the length of the crystal, and 'concentric' twin bands indicate that this second stage of growth served to 'coat' the pre-existing core on both terminal & *m* prism faces.

The distributions of hydrous impurities in quartz provide additional insights into their host hydrothermal systems. Variations in the relative abundance of different chemical species provide insights into changing fluid chemistry, and diffusion profiles observed near crystal edges document thermal events after their growth. We use ion probe analyses to identify individual IR absorption bands and show that the Guangdong crystals document an evolving host fluid chemistry. Their cores show classic diffusion profiles toward the contact with the rims, and suggest the cores had fully grown before the AlOH-poor coating was added onto their respective *m* faces. This phenomenon appears to have impacted all of the crystals within the same vug.

[1] Ihinger and Zink (2000) *Nature*, **404**, 865-869. [2] Jourdan *et al*. (2009) *Eur. J. Mineral.*, **21**, 219-231.