Geophysical Research Abstracts
Vol. 14, EGU2012-3365-5, 2012
EGU General Assembly 2012

Assessment of Rock Magnetic Parameters for Fly Ash Pollution Screening in Topsoil of the Deccan Trap Basalt Area, India

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Rock magnetic parameters of highly magnetic topsoil of the Deccan Trap basalt area are evaluated for their suitability for efficient environmental magnetic pollution screening. Parameters, such as magnetic susceptibility (χ), frequency dependence of magnetic susceptibility (κ fd%), anhysteretic remanent magnetization (ARM), saturation isothermal remanent magnetization (SIRM), soft isothermal remanent magnetization (Soft IRM), as well as thermo-magnetic analysis (κ-T) are compared and assessed for best depiction of topsoil contamination due to ash deposition around the Nashik thermal power station (NTPS). Fifty-five topsoil samples, collected along north-south and west-east stretching transects of 24 km length, are the basis for evaluation of the specific ash distribution pattern around the plant and its adjacent ash pond. Similar decline of the magnetic signals with increasing distance from the point source is observed in the concentration dependent magnetic parameters and can be modeled. The magnetic grain size parameters instead reveal increasing trends with increasing distance. Verwey-transition and Hopkinson peak obtained from κ-T analyses demonstrate to be important parameters to prove fly ash accumulation in soils of basaltic origin. The importance of magnetic parameters for indirect tracing of pollutants, such as heavy metals, is shown by Pb, Zn and Cu data, revealing similar distribution pattern as obtained from the concentration dependent magnetic parameters. Confirmation of the presence of a very high amount of ash particles in the vicinity of the NTPS and a low number of particles in more distant areas is provided by scanning electron microscopy (SEM) on quantitatively extracted magnetic particles at 5.5 km and 11.9 km distance in eastern direction. The investigation demonstrates that the majority of the rock magnetic parameters has the potential to be successfully applied in environmental magnetic studies in areas with high magnetic background values.