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GP21B-9 1110h

The Anisotropy of Magnetic Susceptibility (AMS) Technique to Locate the Source of the Rattlesnake Ash-flow Tuff, Central Oregon.

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As part of a paleomagnetic study on the Rattlesnake Ash-flow Tuff (7.01 Ma) in the northern Basin and Range, we use the anisotropy of magnetic susceptibility (AMS) to determine flow direction, and hence source of the ash-flow tuff.

Ninety-nine (99) specimens from seventeen (17) sites were measured for their AMS. Plotting the shape parameter, T, against the corrected degree of anisotropy, Pj, results in a mean shape parameter of approximately 0.075 (prolate) and the mean corrected degree of anisotropy is approximately 1.030, or 3 percent. The mean bulk volume susceptibilities ranged from 8.0E-04 to 2.0E-02 (SI units).

During the caldera identification procedure, all sites were included in the calculations. After the process was run with all the sites, two sites that had very anomalous flow azimuths were excluded. These two sites produced lineation and foliation directions that are clearly influenced by paleotopography of the ancestral John Day River Valley. Although other sites probably show the influence of paleotopography, but to a lesser degree, they were not removed. Subsequent contouring resulted in no significant difference in the source area location.

The AMS measurements show an approximately radial outflow pattern from the postulated source caldera. Our best estimate as to the location of the caldera would be near Lake on the Trail in the US Geological Survey 7.5' quadrangle by the same name. This location is approximately 10-20 km to the south of previously postulated source regions. With further AMS work at other outcrops, we feel that the source may be better located.

GP21B-10 1125h

Caetano Tuff, Nevada: Distribution and Source Region Inferred From Magnetic Properties

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The Caetano Tuff (Gilluly and Masursky, 1965) is a volume- trically significant ash-flow tuff of late Paleogene age, near 34 Ma, widely distributed over central Nevada. Approxima- tely 6,000 cubic kms of this tuff fill and surround the north- ern of two large volcanic tectonic troughs of central Nevada (Burke and McKee, 1979). Outcrops of tuff assigned to the Caetano by various authors extend from the Tobin Range, across the Fish Creek Mts., Battle Mtn., and Shoshone Range to the Toiyabe Range. For more than 40 sites across this area we have investigated the magnetic properties of Caetano Tuff with the objective of interpreting its structural setting and source regions. Numerous difficulties have arisen including correlation uncertainties, hydrothermal alteration of magnetic properties, near-isotropic fabrics, and scarcity of visible flow-lineation fabrics for cross-checking AMS interpre- tations. Nevertheless, several characteristics have emerged. The remanence, tightly clustered, is all of reversed polarity; this is unexpected in view of the numerous sedimentary inter- calations in the type area, which imply a long interval of em- placement adequate for reversals to occur. AMS Kmax axes, taken as proxies for flow-axes (Ellwood, 1982), are broadly consistent with radial outflow around the trough's west end. Within the trough, Kmax axes are mainly parallel to the trough E-W axis, except at the type area at the east end.

GP21B-11 1140h

Rock Magnetic Characterization and ESR Spectra of Volcanic Ash: A Summary of Results to Date

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The use of rock magnetic properties and electron spin resonance (ESR) spectra as tools to identify volcanic ash requires 1) the properties be uniform within the ash, and 2) different ash units have different magnetic and ESR signatures. The later stipulation should be the case when the ash units have dissimilar chemistries and/or crystallization histories. Magnetic properties and ESR spectra depend on these factors because they reflect magnetic mineral content and grain size and shape. ESR spectra characteristics are also affected by crystal defects, impurities, etc. and the presence of paramagnetic minerals such as ilmenite.

Most information comes from a comparison of results from the Fuego 1974 ash, Guatemala (EOS, 1994, Fall Meeting, p.695), the El Chichón 1982 ash, Mexico, (see previous abstract, this meeting) and ash from ancient eruptions of Kilauea, Hawaii. Atmospheric fraction dramatically affects magnetic properties and ESR spectra in proximal ash from Fuego and El Chichón. Distal ash collected 30 and 100 km distance, respectively, have uniform magnetic properties. Although samples from Kilauea were from the a single location, theoretical considerations based on the lack of atmospheric fractionation argue that magnetic properties should be uniform throughout each ash unit for this volcano. Ash from these three volcanoes can easily be distinguished on scatter plots comparing saturation magnetization and saturation remanence with g, the magnetic field at which maximum ESR absorption occurs. Preliminary data from multiple eruptions of Fuego suggest that the method is ineffective in distinguishing between ash units erupted a few years apart.

GP22A MC: HALL D Tues 1330h
Ash-Flow Tuffs: Correlation and Emplacement II Posters *(joint with V)*
Presiding: **W D MacDonald**, SUNY, Binghamton; **L Brown**, Univ of Massachusetts

GP22A-1 1330h POSTER

Accumulation and Dry-State Remobilization Processes in the June 15, 1991, Ignimbrite at Mount Pinatubo, Philippines

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Pyroclastic flows produced by eruption column collapse during the climactic eruption at Mt Pinatubo on 15 June 1991, were sustained for up to 3 hrs in proximal to medial areas and pulsating in more distal areas. Evidence for progressive aggradation of the ignimbrite is shown in the medial facies (3 to 7 km from vent) along the ODonnell valley; thick, massive, homogeneous valley-ponded ignimbrite changes laterally into stratified and fines-depleted deposits toward the channel margins. Distally, the deposit transforms into a stratified sequence of individual flow units with intercalations of surge and fall deposits. Horizons of coarse pumice concentrations and fine ash and lapilli fallout mark the upper surfaces of flow units. Some massive deposits can be traced down flow into cross-stratified surge-like deposits, suggesting increasing dilution of the solids concentration of the flows as runout increased. These temporal and spatial changes occur in response to variations in mass flux of material transported by the flows. Portions of the 1991 primary ignimbrite were remobilized to form secondary pyroclastic flows and ignimbrites on numerous occasions. These deposits exhibit identical field characteristics, suggesting similar particle support and emplacement mechanisms. Flow velocity and the amount of air ingested at the flow front appear to have little effect on deposit characteristics. Turbulence induced by air entrained during eruption column collapse provide the primary particle support mechanism in flow. Development of a dense underflow through downward increase of particle concentration and damping out of the fluidizing effects of gas cause a basal depositional zone in the flow where hindered settling is the dominant particle support mechanism that controls deposit characteristics.

GP22A-2 1330h POSTER

Vitric - Sillar Zonation in the Bandelier Tuff

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A recent study of the Bandelier Tuff (Tshirege member) motivates a reinterpretation of sillar paragenesis and vitric - sillar zonation in the ignimbrite. Field observations of zonal geometry characteristics agree with previous findings (Smith, 1960, USGSPP 354-F), and are complimented by laboratory analyses of zonal variations in crystalline textures and forms. Results of petrographic, SEM, XRD, and microprobe analyses of sampled profiles evidence sillar zonation defined by polymorphs of alkali feldspar, silica, and marialite that are indicative of a nonequilibrium phase transformation. For example, sillar alkali feldspar occurs in stellate clusters that in thin section are discoidal or polygonal (4,5, and 6 sided), and silica occurs as hexagonal platelets that display β - tridymite crystallography, but with a crystalline structure consistent with that of α - cristobalite. Additional evidence suggests that these forms crystallized directly from the amorphous component (shards and pumice), and not precipitated from a vapor phase. The analytical results also suggest that sillar crystallization occured while the ignimbrite cooled but before attaining the glassy 'state', that sillar crystallization interrupted welding compaction, and that sillar crystallization is degenerative to rock coherence.

GP22A-3 1330h POSTER

The Size Distribution of Pyroclasts and the Fragmentation Sequence in Explosive Volcanic Eruptions

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In an explosive eruption, the atmospheric column regime depends on the mass flux and on the mass fraction of gas in the erupted mixture. Upon fragmentation, vesicular magma rising in a conduit breaks up into small fragments, and the amount of gas released depends on the size distribution of magma fragments. We present a comprehensive review of the grain-size distributions of ash and pumice samples in 26 well-documented Plinian eruptions. These populations follow a power-law distribution. The cumulative distribution is such that N, the number of fragments with radii larger than r, is given by: $N \propto r^{-D}$ where exponent D ranges from 3 to 4. Such values of the exponent cannot be attributed to a primary fragmentation mechanism. We propose a secondary fragmentation sequence involving multiple collisions above the fragmentation level. Laboratory experiments on real pumices illustrate the various possibilities for secondary fragmentation processes and show under which conditions exponents larger than 3 can be obtained. A model of kinetic refragmentation is developed to account for such observations. Primary breakup of bubbly magma leads to a size-distribution exponent smaller than 3, implying a small volume (and mass) fraction for the continuous gas phase in the mixture. In these conditions, particle collisions are frequent and induce an increase of the exponent of the distribution. With increasing height above the fragmentation level, decompression acts to increase the volume fraction of gas and hence to lower the probability of particle collisions. The final value of the exponent is a function of the residence time in the conduit.

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GP22A-4 1330h POSTER

Collapse of Inclined Eruption Columns and the Generation of Directed Pyroclastic Flows

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We present a model of column collapse that relates the asymmetry of a volcanic crater (e.g. presence of crater notches) with the emplacement direction of small scale pyroclastic flows. Analysis of two-dimensional compressible flow behaviour shows that under certain conditions, the streamline of a jet exiting the vent at sonic speeds can become tilted away from the vertical. The inclination of the streamline to the vertical, depends on the slant angle of the crater lip and pressure at the crater exit plane. This tilting in turn focuses the fallout of coarse particles from the jet that may cause the subsequent generation of oriented small scale pyroclastic flows. This model applies to volcanoes with vertical conduits and crater to vent geometries capable of acting as effective sonic to supersonic volcanic jet nozzles. Mayon volcano's near perfect cone, central vent, vent to crater diameter ratio (0.64:1), and conspicuous crater asymmetry as determined from DEM's and photographs, is an excellent example of this type of volcano. The southeast facing crater lip slant of Mayon volcano, which existed prior to its 1984, 2nd phase eruption, is believed to have directed the southeast trending pyroclastic flows. The inclined column collapse model is also consistent with the origin of the pyroclastic flows in the fatal 1902, Mount Pelée eruption. This model provides a means of predicting the likely orientation of small scale pyroclastic flows generated by column collapse at active volcanoes.

GP22A-5 1330h POSTER

Depositional Features and Transportation Mechanism of the 1991-96 Unzen Pyroclastic Flows, Western Japan

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More than 9400 Merapi-type dacitic pyroclastic flows (totaling 0.2 km^3) were produced from lava dome collapse at Unzen Volcano, western