

and ash accumulated before the caldera began to collapse and before the ash-flow phase of the eruption began. The Wineglass Welded Tuff of Williams (1942), a welded ash-flow tuff, records sudden collapse of the eruption column as vent geometry changed during the transition from single to multiple vents. Because the lithic fragments in proximal deposits correlate with local caldera wall rock types, the investigator concluded that the following climactic ash flows came from a ring of vents. Relations on the top of the Cleetwood rhyodacite flow, youngest of the precursory lavas, show that the crust was brittle, but its interior still plastic when the caldera collapsed: rift valleys formed in the crust as the interior oozed down the caldera wall where the scalloped wall bit into the flow. The walls of the rifts cut air-fall deposits and Wineglass Welded Tuff but are partly covered by proximal ash-flow deposits, facts indicating that the caldera had begun to collapse by the time the climactic ash flows were erupted. All of the events, from emplacement of the Cleetwood flow through collapse of the caldera, took place over a short time. The ash-flow deposits represent about 13 km³ of magma, in which rhyodacite is far more abundant than andesite, and the total for the climactic eruption is about 50 km³. Reconstruction of the form of Mount Mazama at the time of the eruption on the basis of mapping of the caldera walls and rim indicates a loss of about 50 km³ attributed to formation of the caldera, an amount equivalent to the volume of magma erupted.

Miocene ash-flow tuffs, central Snake River Plain, Idaho

P. L. Williams and G. B. Dalrymple recognize that four major rhyolite ash-flow tuff units were erupted in late Miocene time and are exposed in the Cassia Mountains and Monument Hills south of the plain and in the Mount Bennett Hills north of the plain. These rocks, for which Williams and Dalrymple propose the name Cassia Group, are 300–400 m thick in the Cassia Mountains and consist of densely to moderately welded tuff sheets separated by bedded tuffs. Isotopic dating by these investigators and by Armstrong and others (1975, 1980) indicates emplacement of the tuffs occurred about 16, 12, 9.3, and 8.5 million yr ago, an age range compatible with that of the Trapper Creek flora (Axelrod, 1964) which occurs in tuffaceous beds conformably underlying the Cassia Group. All the tuffs contain small to moderate amounts of plagioclase and clinopyroxene, but from base to top of the succession they are progressively poorer in K₂O and in SiO₂ (75 to 69 percent) and correspondingly richer in feldic constituents, except for the uppermost unit, which is rich in K₂O and SiO₂. The investigators infer that the lower three tuffs were erupted from the roof zone of a magma chamber that

was vertically zoned by fractionation and was progressively depleted in SiO₂ in the manner described by Smith (1979). The uppermost unit appears to have originated from a source farther east and is the single eruptive product of a small magma chamber.

Eruption rates and lava compositions, Craters of the Moon lava field, Idaho

Field, paleomagnetic, and radiocarbon studies by M. A. Kuntz, D. E. Champion, E. C. Spiker (USGS), and R. H. Lefebvre (Grand Valley State College, Michigan) reveal a time-dependent relation between repose intervals and the volume (thickness times area) of lava erupted in each successive period in the Craters of the Moon lava field. The field formed in the last 15,000 yr during eight eruptive periods. Each eruptive period was probably several hundred years in duration, on the basis of paleomagnetic evidence, and eruptive periods were separated by repose intervals of several hundred to several thousand years.

The eruption rate for the eruptive periods between 15,000 and 7,600 yr ago was about 1.7 km³ per 1,000 yr; the eruption rate for the eruptive periods between about 6,600 and 2,000 yr ago was about 2.7 km³ per 1,000 yr. The increase in eruption rate coincides with a marked change in composition. Prior to 7,600 yr ago, only basalt lavas (less than 50 percent SiO₂) were erupted. After 6,600 yr ago, both basalt and hawaiite-trachyandesite (more than 50 percent SiO₂) were erupted. The eruption of more fractionated lavas was accompanied by building and partial destruction of large cinder-spatter cones; the eruption of basalt lavas was mainly from fissures and was relatively nonexplosive.

The increased eruption rate results from addition of more fractionated lavas, at a rate of about 1.0 km³ per 1,000 yr, to the basalt component, which remained fairly constant at about 1.7 km³ per 1,000 yr. Petrographic and chemical data suggest that fractionated lavas represent a mixture of basalt magma and a partial melt component from deep crustal, granulitic rocks.

Differentiation in the Springerville volcanic field, Arizona

J. C. Aubele, L. S. Crumpler, and Christopher Condit found that the Springerville, Ariz., volcanic field contains basanite, alkali basalt, hawaiite, mugearite, benmoreite, and andesite in vents and flows dating from several m.y. to less than 100,000 yr old. Two vents have produced andesite plugs within benmoreite and alkali olivine basalt cones. A number of vents produced aphyric basalt flows, generally hawaiites, that cover the topographically highest central part of the field. These may represent a fractionated product from an alkali basalt magma that resided in the upper crust. Similar