Influences of Magmatic Water on the Development of Microtextures in Flow Banded Rhyolites

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The effects of water concentration and degassing history on the development of spherulites and flow banding were examined in three middle Tertiary rhyolitic lava flows from the Atascosa Mountains of southern Arizona. Two of these lavas host spherulites of strongly contrasting texture, and neither are flow banded. The third is a flow banded rhyolite that hosts two populations of spherulites. In some cases, spherulites consist of two to four generations of bladed radiating alkali feldspar crystals that increase in water concentration along their length. Differences in spherulite crystal morphology (needle-like vs bladed) reflect differences in cooling rates. Thick gray flow bands in the the banded lava flow host higher water concentrations than thin orange flow bands, suggesting that flow bands are zones of greater and lesser volatile concentration, deformed by stretching of the flowing magma. Calculation of water concentration profiles in spherulites from all three rhyolite flows shows that the very high water concentrations in spherulites (typically >0.6 * water concentration in surrounding glass) cannot be accounted for by Rayleigh fractionation. Instead, sanidine incorporated water as fluid inclusions and/or as 'water clusters'during rapid crystal growth. Water concentration profiles in the glass surrounding spherulites do not preserve the high concentration zone at the spherulite boundary that has been observed in younger lava flows. Rather, the water concentration profile in the surrounding glass is a half plateau, the height of which is approximately equivalent to the far field water concentration in the surrounding glass, indicating that water that accumulated at the spherulite/magma boundary diffused sufficiently rapidly to equilibrate with the surrounding magma as the lava flow cooled.