The emplacement dynamics of intrusions controls their temperature and melt fraction distribution over time and thus the ability of magma to convect, differentiate and feed volcanic eruptions. It is now well accepted that most large intrusions are incrementally emplaced, but the size and shape of magma increments can be difficult to estimate.

If the size of an intrusion and the initial temperature of the country rock can be estimated, the size of the thermal aureole resulting from the instantaneous emplacement of the intrusion can be calculated. A significant difference between the observed and calculated aureole sizes would suggest that the intrusion was slowly and incrementally emplaced. We numerically simulated incremental emplacement of large, tabular intrusions and calculated the size of their thermal aureoles. Incremental emplacement produces thermal aureoles of different sizes at the upper and lower contacts. The respective sizes of the thermal aureoles vary with the intrusion emplacement rate. If the time interval between two increments of intrusion exceeds the heat diffusion timescale of the increments, the thermal aureole size will be controlled by the size of the largest increment and will be independent of the final volume of the intrusion. For example, the Manaslu leucogranite (High Himalaya) that is several kilometres thick has a very narrow thermal aureole (< 100 m), which suggests slow emplacement by accretion of sills each less than 100 m thick.

Numerical simulation of aureole formation can be used to constrain the maximum sizes of magma increments and improve our understanding of intrusion dynamics.