Vc-012 会場：C102 時間：6月10日 11:42-11:54

溶岩流に見られる各種のドメイン状組織とそれらのキネマティックおよびレオロジカルな説明：日本とオーストラリアの例

Varieties of domainal textures in lavas and their kinematic and rheological interpretation: Examples from Japan and Australia

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溶岩の岩石中の組織に見られる結晶とガラスの分布と配置はほとんど均一であることはない．ふつうの場合，ランダムではなくて識別できるほどの複数のドメインが不均一に分布している．各々のドメインの中では組織は比較的均一であり，複雑に見える組織も数少ないタイプのドメインからなっているようである．組織上のドメインの成因は固結しつつある溶岩の力学的性質と溶岩流の流動との相互作用である．したがって，ドメイン状の組織について明確に理解することにより，溶岩のキメマティックスおよび何らかのレオロジカルな傾向を説明することが可能になる．

The distribution and configuration of crystals and glass in lavas are rarely homogeneous but are more commonly inhomogeneous. The inhomogeneity can commonly be recognised as belonging to domains within which relatively homogeneous textures occur. Textural domains can be defined by variations in both the concentration and alignment of crystals. Variations in crystal concentration are commonly observed in banded rhyolites and result from extreme stretching of pockets of magma with different crystal concentration. Other processes which can produce crystal concentration domains include: 1) aggregation during flow producing clusters of crystals, 2) migration of melt during compaction of magma and 3) the collapse of vesicles leaving interconnected glass-rich domains.

Of greater interest to the study of the movement of magma are textures defined by the variations in the alignment of crystals. The most commonly observed texture of this type contains planar zones in which the crystals are aligned parallel, or at a low angle, to the zone. These domains are interpreted as shear zones which formed while the magma contained a fluid melt component. The texture in the domains either side of the shear zone indicates the nature of the texture which preceded the development of the shear zones. This earlier texture can be non-aligned to poorly aligned, strongly aligned or may even contain the remnants of shear zones in an earlier domainal texture. Where the pre-existing texture is an aligned one, the later shear zones are commonly oriented obliquely to the earlier crystal alignment. This indicates that the pre-existing texture was undergoing orthogonal flattening prior to, and at the inception of, localized shearing.

The domainal shear zone textures occur in two main forms: 1) single or conjugate shears disrupting a dominant crystal alignment and/or banding texture and 2) dominant alignment texture with isolated remnants of an earlier alignment texture. These two types of domainal texture represent different degrees of development. The former textural type indicates that the magma was not flowing rapidly but only deforming slowly under the effects of adjacent magma pressures. These pressures were sufficient to deform the magma during the final stages of its solidification. The latter textural type indicates that magma was flowing relatively rapidly during solidification. Shear textures are generally most common near the margins of flows where solidification inward from the cooling front overlaps with flow driven by the internal magma pressure. This includes the carapace of domes, the base of lava flows and the margins of lava tubes. Shear textures can also occur due to local disturbances such as the collapse of large vesicles or vugs.

Domainal textures provide information about the kinematics of flow. This includes simply the magma flow direction but more complex interpretations include the vorticity of the flow between the end states of coaxial pure shear and non-coaxial simple shear. These interpretations can also be extended back in time. For example the vorticity of the flow indicated by a set of shear zones which have been preserved soon after their formation can be interpreted to be consistent with the type of flow occurring immediately prior to the formation of the shear zones. Thus the flow kinematics of the pre-existing textural type can be inferred. This approach has provided an opportunity to differentiate between models of formation for crystal alignment textures. That is, crystals are aligned parallel to the plane of shear flowage or crystals are aligned parallel to the principal strain plane which rotates progressively toward the shear plane. The general symmetry of shear zones across the plane of pre-existing crystal alignments supports the latter model.