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From Melting to Pluton

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A granitic pluton is the consequence of melting (M) induced by the heat and material coming from the mantle (m). This process is continuous. Melt segregation (S), melt ascent (A) and emplacement (E) follow, driven by the external stress field. Those are essentially discontinuous in space and cyclic in time, leaving melt pockets that aggregate to form veins and dykes. The whole process has been referred to as m(M-SAE).
In the former melting, assimilation, storage and homogeneization (MASH) concept, the source region for granitic melts is commonly represented by migmatites, passing progressively to diatexites and anatectic plutons. In such a case, melting is pervasive, and the leucosome should progressively segregate to form melt “layers”. Gravitational and viscosity-driven instabilities should led to small diapirs or dykes through which melt ascends to form larger-scale plutons. The discordant fabrics observed in contiguous mineral facies indicate the progressive and discrete building of a pluton by successive magma inputs, eventually with different chemistry.
According to the new paradigm m(M-SAE) paradigm, melting is continuous and pervasive, being driven by heat and diffusion. Conversely, SAE is discontinuous in time and space. Therfore, we expecetd to see isolated melt pockets with leucosome within an unmolten matrix. The melt should segregate into discordant veins. Those veins should focus melt into larger and bigger dykes that finally bring granitic melt and form small individual plutons.
We present a slide show of a crustal cross section from the Damara Belt, Namibia. The section shows the progressive melting of metapelitic rocks up to the formation of small scale granitic plutons.
Starting from metapelitic rocks, a fisrt stage of melting (qz + bt+ pl + H2O –> melt $\pm$ cord $\pm$ grn) results in isolated melt pockets, decimetric in scale and at high angle to the stretching lineation. They consist in the usual leucosome with or without restitic garnet. Some of those pockets lack their leucosome, but show pucker structure indicating that melt has been sucked out. The estimated density of those melt pockets is about 15%, but nothing indicate that they formed at the same time. They intersect and fill small veinlets, often parallel to the lineation and about 10 cm in width.
This first stage of melting and segregation progressively transforms into series of melt veins that develop strain partitioning. It results in the usual shear zones that contribute to focus melt into wider conduits. Those conduits preferentially follow the anisotropic foliation planes. Dykes progressively transfer melt by merging. They result in larger dykes, up to a metric scale that progressively invade all the surrounding rocks. They finally end forming small plutons, kilometric in scale.
The present slide show clearly indicates that melt segregation and ascent is a discontinuous process, in both time and space. The leucocratic melt is transferred from isolated melt pockets to dykes that become wider and wider. The transfer zone is also the place of melt focusing toward large dykes that progressively fill isolated granitic plutons.