American Mineralogist, Volume 101, pages 297–310, 2016

SPECIAL COLLECTION: PERSPECTIVES ON ORIGINS AND EVOLUTION OF CRUSTAL MAGMAS

Mafic replenishments into floored silicic magma chambers

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Abstract

Commingling between contemporaneous mafic and felsic magmas is now widely recognized in a broad range of intrusions and intrusive complexes. These interactions are important features for two main of reasons: (1) the rapidly chilled margins of mafic magma against silicic magma commonly preserve the compositions of mafic liquids, and (2) because the mafic magma solidifies rapidly, the resulting (final) configurations of mafic and felsic magmas can provide insights into physical processes and changing viscosity contrasts and rheologies of magmas and felsic crystal mush during crystallization of the mafic magma.

Mingling of contrasted magmas was first recognized in the 1950s. Wider recognition of interactions between mafic and silicic liquids led to concepts of "net-veining" in the 1960s, "intramagmatic flows" (chilled basaltic layers separated by felsic cumulates) in the 1970s, and in the 1990s to "mafic-silicic layered intrusions" (MASLI), which could be as much as a few kilometers thick and more than 100 km^2 in area. It was quickly appreciated that these MASLI preserved stratigraphic records of mafic replenishments into silicic magma chambers floored by felsic crystal mush. Volcanic studies had anticipated the occurrence of this last type of intrusion on the grounds that extensive ponding of basaltic magmas beneath silicic chambers was seen to be essential to keep large silicic systems like Yellowstone active for millions of years. This paper looks at the history of changing perceptions and interpretations of magma mingling and whether or not "sill complexes" are distinct from mafic-silicic layered intrusions. The stratigraphy of mafic-silicic layered intrusions records changing magmatic compositions, events, and processes in a temporal framework comparable to that provided by coeval volcanic rocks. As a result, careful study of MASLI has great potential for linking plutonic and volcanic processes and events.

Keywords: Magma mingling, granite, gabbro, net-veining, mafic-silicic layered intrusions