IMPLICATIONS OF MUSCOVITE CRYSTALCHEMISTRY AND ELASTIC PROPERTIES FOR THE FORMATION OF THE SLATY CLEAVAGE

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During slate formation several effects occur for muscovite: (1) phengite-content (Fm) increases, but Na/Na+K ratio, tetrahedral alfa rotation, and d(001) decrease; in contrast, a and especially b-cell dimension increase; (2) c decreases as Fm increases, but cell volume increases because the a & b increases override c decrease; (3) muscovite is more Fm, K, and Si-rich in P-domain than in the intervening Q-domains.To better interpret these observations, the interrelation among composition, crystal structure and compressibility (beta) of muscovite was considered. Key points are: (1) compressibilities and structural adjustments are related to Na/Na+K ratio (beta increasing with K-content); (2) most of the compression involves shortening of c; (3) the structural adjustments (alfa angle, dimensions of IV and VI sheets, etc.) tend to destabilize the structure.These observations have importance for understanding the foliation of slate formation. As slate forms, platy minerals like muscovite align by some combination of rotation and recrystallization, so (001) planes are perpendicular to the direction of maximum compression. Compositional changes by muscovite segregated into P-domains indicate significant recrystallization during preferred orientation formation. Moreover, the pronounced dimensional changes accompanying the muscovite compositional changes exactly mirror the strain experienced by the rocks as slates form. Also, the intrinsic compressibility of muscovite increases measurably as K increases, thereby possibly facilitating further the ease of rock flattening.In conclusion, the above noted chemical, dimensional, and compressibility aspects of muscovite in response to the P(total) and differential stress strongly enhances its recrystallization into the highly preferred orientation typifying slates.