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COMPETENCY CONTRASTS AND THEIR IMPORTANCE FOR LOCALISING PERMEABILITY NETWORKS AND HYDROTHERMAL MINERAL DEPOSITION

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Background

Competency contrasts are important for localising permeability networks and hydrothermal mineral deposition. The lithologies with relatively coarser grainsize, relatively finer-spaced layering, and relatively lower phyllosilicate content, have sponsored preferential fracturing and focused vein emplacement. Furthermore, the composition of the rocks and the percentage of different minerals has also played a role, including influencing strain partitioning. For example, a coarse-grained rock that is much more feldspathic will be more likely to preferentially fracture and/or boudinage relative to a fine-grained one dominated by quartz and mica (think of a granite vein in a well bedded sedimentary assemblage).

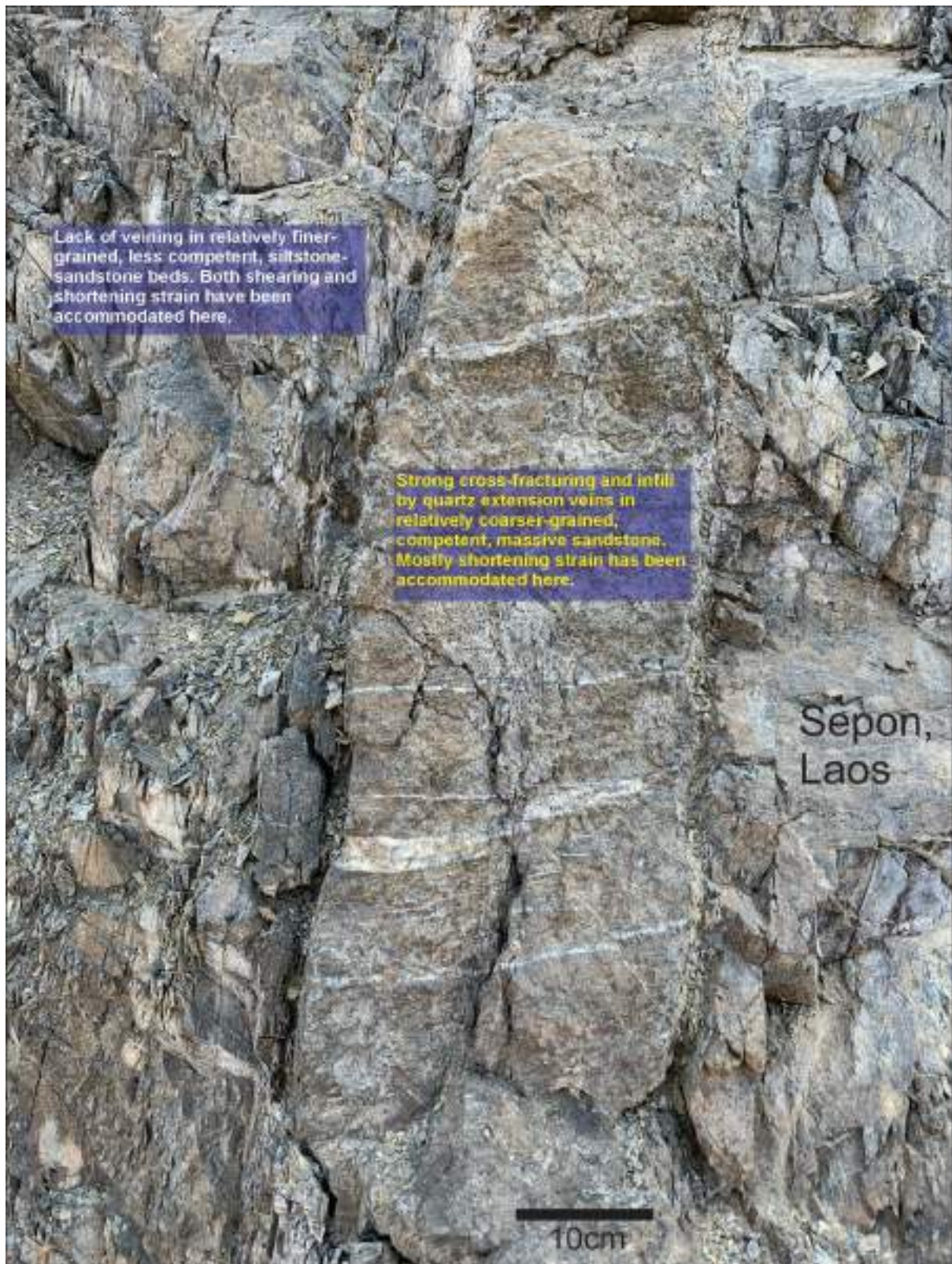
In the following photos, veins in the competent lithologies tend to have greater volume/thickness and a greater range of orientations relative to the adjacent less competent units. This is apparent in the photographs here, where the veins in the competent lithologies commonly (not always) terminate at the boundaries of the competent units. This indicates that much of the permeability and fluid movement and mineral deposition occurred within the host (e.g. along a competent bed) rather than the adjacent less competent units. This doesn't preclude lesser permeability in the less competent adjacent lithologies and along lithological contacts, which can be sites of deformation-enhanced dissolution and fluid movement. However, it does inhibit the creation of space to deposit minerals from the fluids responsible, with development of veining in the competent units being preferred where space creation is easier.



Note that the competency has also influenced vein orientation, with refraction occurring across the layer boundaries.



Note that the vein stockworks will have intersection lines that will be closely oriented, producing linear geometries in the plane of layering. This is akin to shoot development.



Note that most of the deformation of the competent layer has been achieved by extensional fracture, with any boudinage/pinch-and-swell being exceptionally minor.

Distribution of the different units and their relative volumes in the rock mass?

An important consideration in the localisation of the permeability and hydrothermal mineral deposition is the distribution of the different units and their relative volumes in the rock mass. For example, the distribution of permeability, veining and grade will be different in sequences of alternating competent and incompetent units when compared to a single competent layer embedded in a large volume of incompetent material. In the former case, we would expect relatively more distributed, and lower, average grades compared with potential shoot development in the latter case. Similarly, the distribution of the different units and their relative volumes in the rock mass will influence the distribution of strain, which will vary, along with the location of sites, such as low mean stress positions, that will preferentially focus fluids.

The examples here are a small subset of the many types, scales, orders and geometries of competency contrasts developed in hydrothermal mineral deposits. The boudinage of competent units is another obvious product of this, but will be dealt with in later posts.