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Joints, shear fractures and ductile shear zones in a cooling pluton: the example of the Lake Edison Granodiorite (Sierra Nevada, California)

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In the Lake Edison (LE) granodiorite (88Ma) of the Bear Creek area (Cretaceous Mono Pass intrusive suite, Sierra Nevada, CA) different sets of fractures developed during the high temperature stages of post-magmatic cooling. These fractures strongly localized successive ductile and later brittle shear deformation, but many pristine fractures do not show any shear offset (i.e. are joints). Away from the contact with the younger (86Ma) Mono Creek granite, the LE granodiorite mainly show a single dominant set of steeply dipping fractures striking around E-W to ENE-WSW which were exploited as left-handed strike-slip ductile shear zones and later as faults with identical kinematics. In the proximity of the contact, a second (dominant) set of steeply dipping fractures is present, striking about NNE-SSW, with a right-handed ductile shear reactivation and forming a conjugate array with the E-W set; many leucocratic dykes (including pegmatite) also localized the shear deformation within the granodiorite. Left-handed shear zones and the precursory joint/fractures commonly overprint the right-handed ones, but the opposite is also observed. The two conjugate sets of ductile shear zones are associated with a background solid state foliation in the host granodiorite which is mainly developed towards the pluton contact and which has been referred to the Rosy Finch Shear Zone in the area. The attitude of the foliation is orthogonal to the bisector of the small angle between the two sets of joints/fractures/ductile shears. The mineral fabric along the foliation and along both the left- and right-handed localized shear zones indicate deformation T>500°C. This suggests that all the structures are coeval developing under the same stress field and that joints actually develop in an orientation typical of shear fractures.