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Elliptical deformation as a possible stress indicator (Lazufre volcanic area, Central Andes) investigated through InSAR and GIS studies

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Intraplate stress in active tectonic areas affects the orientation of dikes and magmatic reservoirs. Calderas, which are the surface expressions of underlying large-scale reservoirs, such as Yellowstone, Long Valley and Novarupta in North America, and as in east African and Icelandic rifts, are often elliptic in shape and may be used as a stress indicator. The long axis of caldera morphologies is in many cases perpendicular to the maximum principal stress and may be used as a complementary proxy to estimate the regional stress orientation at the time of the eruption. Using Radar Interferometry (InSAR) observations we analyse a large elliptical deformation in the Lazufre volcanic area in the Central Andes that is comparable in size with caldera systems. It shows displacements within a rate of 2 to 3 cm/yr since 1998 with a source depth located between 9 and 18 km depth. This deformation affects an area larger than 1500 km2 and the long axis strikes in NNE-SSW direction. To understand this deformation from a geological point of view and to test its possible relation with the regional stress, we use Landsat images and 30m resolution digital elevation data to map out lineaments such as faults, topographic contrasts and river valleys in the surrounding of the deformation. We find that lineaments follow a NNE-SSW direction which is similar to the direction of the Lazufre deformation. The similarity of the strike direction of the InSAR derived doming region and the lineaments is implying a structural or a genetical relationship. In addition, other complementary and independent criteria such as focal mechanism solutions and geological observations show that the maximum horizontal stress direction follow regionally a similar NNE-SSW direction at this latitude. Thus, our results suggest that the current elliptical region of updoming may be used to assess and identify the regional stress direction.