**Supplemental Material**

Fig. S1: Lithostratigraphic logs and correlation panels highlighting the main depositional architecture and injection-related large-scale deformation of the depositional units; dating after Martin (1975) and McGuire (1981). Frequency and trend of high angle dikes are shown in the different zones of the PGIC stratigraphy and in the key outcrop areas. Orientation of all measured intrusions is shown in a stereo-plot within the transect from Moreno Gulch to West Tumey (data are not back rotated).

Fig. S2: Oblique view to the north of the Panoche Hills from Right Angle Canyon to Moreno Gulch. The geological map is overlain on the topographic surface and sandstone dikes are marked in red. Note the presence of two dominant sets of dikes striking SW-NE (trench orthogonal) and NNW-SSE (trench parallel); B: 3D rendering of the sandstone dikes. Dikes are represented by discs with the same strike and dip as the actual dikes and with diameter equal to their measured length at outcrop; the only dikes shown are >15m long and with width (aperture) >0.3m.

Fig. S3 A: Satellite image and interpretation of the lower and medial portion of the PGIC exposed in Moreno Gulch. Location of the sedimentological logs in B is shown. B) Correlation panel of sedimentary logs from the lower dike zone (LDZ) highlighting the depositional architecture of the main parent units (Uhalde and Dosados ssts) exposed in Moreno Gulch. Uhalde Sst: channel complexes and associated overbank deposits, form laterally-continuous sandstone-rich units (for example: S4 – S5; see fig. 4 and fig. S9) that are intercalated with thick mudstone (for example: M4). Sandstone intrusions (i) are unusual, and the depositional sandstone-rich units have abundant evidence of liquefaction and only local evidence of sand injection. Parent units associated with sandstone intrusions are isolated to partly amalgamated channels encased within mudstone in the Dosados and Tierra Loma mbrs. Direct genetic relationships between depositional sandstone and intrusions are exposed. C) Mid-fan channel Uhalde S1 (Lathrop Sst), west of Silver Creek area. OB – overbank deposits (mainly interbedded fine sandstone and siltstone)

Fig. S4: Capita Canyon area (fig. 5A and fig. S3). Correlation panel showing injection-related deformation in a 25 m thick turbiditic channel complex cut by a 5 m aperture dike. Shading indicates the degree of deformation related to fluidization in the depositional unit associated with the dike. Partially preserved depositional units have remnants of original bedding and lamination, marked in white (PGIC, Panoche Formation; Capita Canyon area). Note the common occurrence of vertical banding (up to 5m long, fig. 6B) across the entire section and the anticlinal structure 10-15 m away from the dike (see fig. 4C).

Fig. S5: Correlation panel showing injection-related features in the upper 100 m of the Uhalde S3, from which a sandstone dike emanates. The unit is dominated by largely structureless sandstone with occasional sub-vertical dewatering bands and other liquefaction features (dark yellow areas). Original depositional structures, such as bedding and lamination, generally with some evidence of soft sedimentary deformation, are preserved locally (light yellow areas).

Fig. S6: Satellite image and interpretation of Right Angle Canyon outcrop area, see Fig. 1 for location. Note only large intrusions (l >5m and a>0.5m) are mapped.

Fig. S7: Satellite image and interpretation of Marca Canyon outcrop area, see Fig. 1 for location. Note only large intrusions (l >5m and a>0.5m) are mapped.

Fig. S8: Satellite image and interpretation of Capita Canyon outcrop area, see Fig. 1 for location. Note only large intrusions (l >5m and a>0.5m) are mapped.

Fig. S9: Satellite image and interpretation of Moreno Gulch outcrop area, see Fig. 1 for location. Note only large intrusions (l >5m and a>0.5m) are mapped.

Fig. S10: Satellite image and interpretation of Dosados Canyon outcrop area, see Fig. 1 for location. Note only large intrusions (l >5m and a>0.5m) are mapped.

Fig. S11: Satellite image and interpretation of Tumey Gulch outcrop area, see Fig. 1 for location. Note only large intrusions (l >50m and a>1m) are mapped. Sills, together with minor dikes, mostly form thick (up to 30 m) swarms of intrusions (fig. 6).

Fig. S12: A) Map of the sandstone dikes (red lines) mapped from satellite images. Deformed and partly remobilised sandstone units within the regional seal M3 are shown (yellow polygons). B) Correlation panel through the Panoche Hills showing vertical and lateral variation of N:G within a stratigraphic section extending from the base of the Uhalde Sst to the Cima Lentil. N:G estimates are derived from cm-scale sedimentary logs, including twelve logs extending through the entire stratigraphy of the PGIC (see also Scott, 2009; Scott et al, 2013). Quantitative image analysis performed on high-resolution satellite images (0.26 m resolution, Scott et al. 2013) is used to infer the N:G between the logged sections and in areas where logs are unavailable.

Fig. S13 Correlation between the sedimentary log from Escarpado Canyon and the nearest borehole: A) McGuire, 1988; B) this study. Both logs were measured at the same locality and the difference in thickness is probably due to different conversion factors between apparent to true thickness. Note that McGuire (1988) does not report any sandstone within the base Tierra Loma Mbr or at the base of the Cima Lentil. The bulk of this sandstone consists of intrusions (mainly sills and low-angle dikes) with a cumulative thickness of >60 m (about 10% thickness of Moreno Fm). Given the extent and scale of the PGIC at outcrop it is conceivable that an injection complex of the size of the PGIC continues in subsurface of the San Joaquin Valley. This is confirmed by the interpretation of saucer-shaped intrusions from 3D seismic data (Huuse and others, 2014) and from the reports of sandstone dikes in core from boreholes drilled into the late Cretaceous section (mainly Moreno Fm and equivalents). Borehole core is sparse, which hinders the possibility of making regional correlation and makes of geological interpretation of borehole logs essential. Publicly available borehole logs consist almost exclusively of spontaneous potential (SP) and resistivity logs, which measure along the borehole margin and deeper into the formation, respectively. The log signatures of the sandstone-rich parts of the PGIC (essentially the SZ and lower part of the UDZ, Dosados to Marca mbrs) in boreholes located in close proximity to the outcrops, have a ratty appearance (compare with De Boer and others, 2007). This log pattern is interpreted to reflect that the SP log only occasionally intersects some sandstone along the borehole, the resistivity log reads the presence of more sandstone (likely intrusions) further into the formation. This interpretation of the log is consistent with observations in boreholes where log signatures are calibrated with core data (see also: De Boer and others, 2007). Therefore, the top of the sand rich portion of the PGIC in the borehole logs is placed at the top of the zone characterized by this specific log signature (Fig. S14). This is a coarse approximation and carries medium confidence, however it correlates with core and seismic data and is the best we can achieve with the available data.

Fig. S14:A and B, correlation panels between outcrop and subsurface: ES, Escarpado Canyon; Ro, Rosetta Canyon; MC, Marca Canyon. The trends of the sections are shown in (C): red line, panel A; blue line, panel B. Sedimentary logs and related N:G measured at outcrop are shown. Note that there is a general agreement between the thickness of the sandstone-rich portion (N:G > 0.10) of the PGIC in the subsurface and the sections with the highest N:G observed from outcrops. Note that Ro and MC logs were measured approximately 2 km W of the nearest well (well 53) in panel B. The log in Escarpado is located 1.5 km from the nearest well. The black bars at wells 17 and 31 indicate the sections where sandstone intrusions are interpreted from core.

Fig. S15:A) Map showing the location of the wells used to estimate areal extent and thickness of the sand-rich portion of the PGIC. See Table S16 for well name. The areas shaded in light green indicate where sandstone intrusions are interpreted from core descriptions (includes also wells not listed in table S16). B) Isopach of the PGIC estimated from outcrop and wireline logs.

Table S16 - list of the wells and estimated thickness of the sand-rich portion of the PGIC from wireline logs.