Tertiary stratigraphy composition plots

The following figures (Figs. DR-2 – DR-6) show plots by location and formation in the Gar Basin. See Figure DR-7 for clast counts sites.

Abbreviations used in clast count/composition plots

Sedimentary clasts:
LS (gy) – gray limestone
ch – chert
ss – sandstone
Kailas cgl – Kailas conglomerate
sh – shale
slt – siltstone
mdst (gy) – gray mudstone
mdst (gr) – green mudstone
mdst (r) – red mudstone
cgl – conglomerate
ep cgl – epidote conglomerate
.
Metamorphic clasts:
qte (w) – white quartzite
qte (r) – red quartzite
ep – epidote
phy (r) – red phyllite
phy (gy) – gray phyllite
phy (gr) – green phyllite
biot sch – biotite schist
chl sch – chlorite schist
musc sch – muscovite schist
ct – cataclasite
paragn – paragneiss

Igneous clasts:
An (gy) – gray andesite
An (gr) – green andesite
An (r) – red andesite
An (p) – purple andesite
leuco gr – leucogranite
vein qtz – vein quartz
rhy –rhyolite
gr – granite
pxn – pyroxenite
di – diorite

Data and processing methods

Contents of geodatabase

The Ayi Shan-Gar Valley geodatabase is an ArcMap GIS[†] (Geographic Information System) database located in the University of Houston Department of Earth and Atmospheric Sciences. The database contains the following data for the study area.

1) 1 Landsat Enhanced Thematic Mapper Plus scene (Landsat ETM+) (30 m resolution)
   LE71450382006275PFS00 (satellite acquired 2006/10/2, downloaded 11/2006)

2) Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER)
   A. 4 scenes with Visible-Near-Infrared (VNIR) bands R-G-B=3-2- 1 (15 m resolution)
   AST_L1A.003:2022017250 (satellite acquired 2004/3/18, downloaded 06/1 2005)
   AST_L1A.003:2022017272 (satellite acquired 2004/3/18 downloaded 06/1 2005)
   AST_L1A.003:2026816706 (satellite acquired 2004/12/6 downloaded 06/1 2005)
   AST_L1A.003:2017875303 (satellite acquired 2003/10/10 downloaded 06/1 2005)

   B. 12 band-ratio images (30 m resolution)

3. 16 tiff images from scanned declassified CORONA (~2 m resolution)

4. Shuttle Radar Topography Mission (SRTM) data (~90 m resolution)
   A. Digital elevation models (DEMs)
   B. Slope maps
   C. Shaded relief images

Data processing

Raw ASTER data were downloaded from http://glovis.usgs.gov/ and processed with ENVI[‡] software to be able to manipulate a scene. A standard file was created to be able to combine band ratios and visually inspect the scenes. SRTM[§] (version 2) data were downloaded from http://www2.jpl.nasa.gov/srtm and also processed in ENVI to create DEMs and hill shaded images. A slope map was derived in ENVI using the *Topographic Modeling* algorithm with a kernel size = 3 and choosing the *Compute Slope* function from the *Topographic Measures* menu. A shaded relief image was also created (Topographic Measures menu, parameters: azimuth= 315°, altitude = 45°). CORONA strips were scanned at 300 dpi and saved as high resolution tiff images.

ASTER and Landsat high resolution tiff images scenes, and CORONA tiff images were exported from ENVI and imported into ArcMap v. 9.3. These scenes were then georeferenced onto an

SRTM-derived DEM basemap using well-known control points such as GPS latitude and longitude coordinates, intersection points of linear features (i.e. roads) with geomorphologic and topographic features, and matching-up topography and geomorphology to create spatial links between the images and the basemap. A minimum of 8 control points were used for each scene (RMS error ≈ 0). Each image was then rectified using the *Rectify command* available in the *Georeferencing* toolbox in ArcMap to minimize distortion of the georeferenced scenes and facilitate interpretation.

The database has the World Geodetic Survey 1984 (WGS 1984) datum.

Forward modeling of intrabasinal structures

Cross-section C-C' (Fig. 2A, 2B) was used to model the fault geometry, basin scale anticline, and calculate the amount of E-W extension using intrabasinal fault geometries because it approximates the slip direction of intrabasinal faults. We input the stratigraphy and major fault geometries as shown in C-C' as simple lines in 2DMove 5.1. 2DMove structural modeling software[#] is a tool that is used to reconstruct deformation using cross-sections as either forward models or restorations. We used the *Inclined Shear algorithm* to model extension along the Gar fault to reproduce the final geometry presented in C-C'.

We made several assumptions: 1) deformation of the hanging wall resulted from slip on the Gar fault, 2) deformation occurred on antithetic shear planes dipping 60° to the west, 3) no deformation occurred on the footwall of the Gar fault as the hanging wall deformed, 4) slip occurred from west to east.

We slipped the system in steps so that the resulting geometry satisfies the (real) outcrop exposure of granite in the eastern margin and the lack of exposure of the Great Counter Thrust (GCT). We assumed that the unconformity found between the Gar basin fill and the Tethyan Sedimentary Sequence (TSS) developed during or after slip on the GCT. Thus, the GCT is a primary structure that was used to control the maximum amount of slip that can be calculated on the Zha Jiang, Gar, and Karakoram faults. The detachment depth of 1.2 km satisfies the overall anticline geometry of the basin fill. We calculated, by slipping each fault (Zha Jiang fault -8.4 km of slip, 5 km of E-W extension; Gar fault - 1.3 km of slip, 1 km of E-W extension; Karakoram fault – 2.4 km of slip, 2 km of E-W extension) a total of 8 km of E-W extension. Because out-of-plane motion along the faults and displacement along the Ayi Shan were not accounted for, this is a minimum estimate for E-W extension solely for the intrabasinal faults of the Gar basin which helps us understand the earlier history of the releasing bend basin.

† ESRI- Environmental Systems Research Institute, Inc.
‡ ENVI -Environment For Visualizing Images, ITT-VIS (Visual Information Solutions) Corp.
§ Shuttle Radar Topography Mission data is housed at the Jet Propulsion Laboratory, California Institute of Technology, and is headed by the National Geospatial-Intelligence Agency (NGA) and the National Aeronautics and Space Administration (NASA).
# Midland Valley, Ltd.

Figure Captions

Figure DR-1. Bend classification map. Basemap is a DEM derived from SRTM (Shuttle Radar Topography Mission) data, 90 m resolution. A) Uninterpreted DEM. B) Outlined western margin of the Gar Basin shows the three orders of classifications. Green-1st order, Red-2nd order, Yellow-3rd order. Figures C-E show detail on the margin bends on ASTER 15 m resolution scenes.

Figure DR-2. Conglomerate clast counts and compositions for various locations in Tcg1. Location is in parentheses according to measuring station. For clast count locations, see Figure DR6.

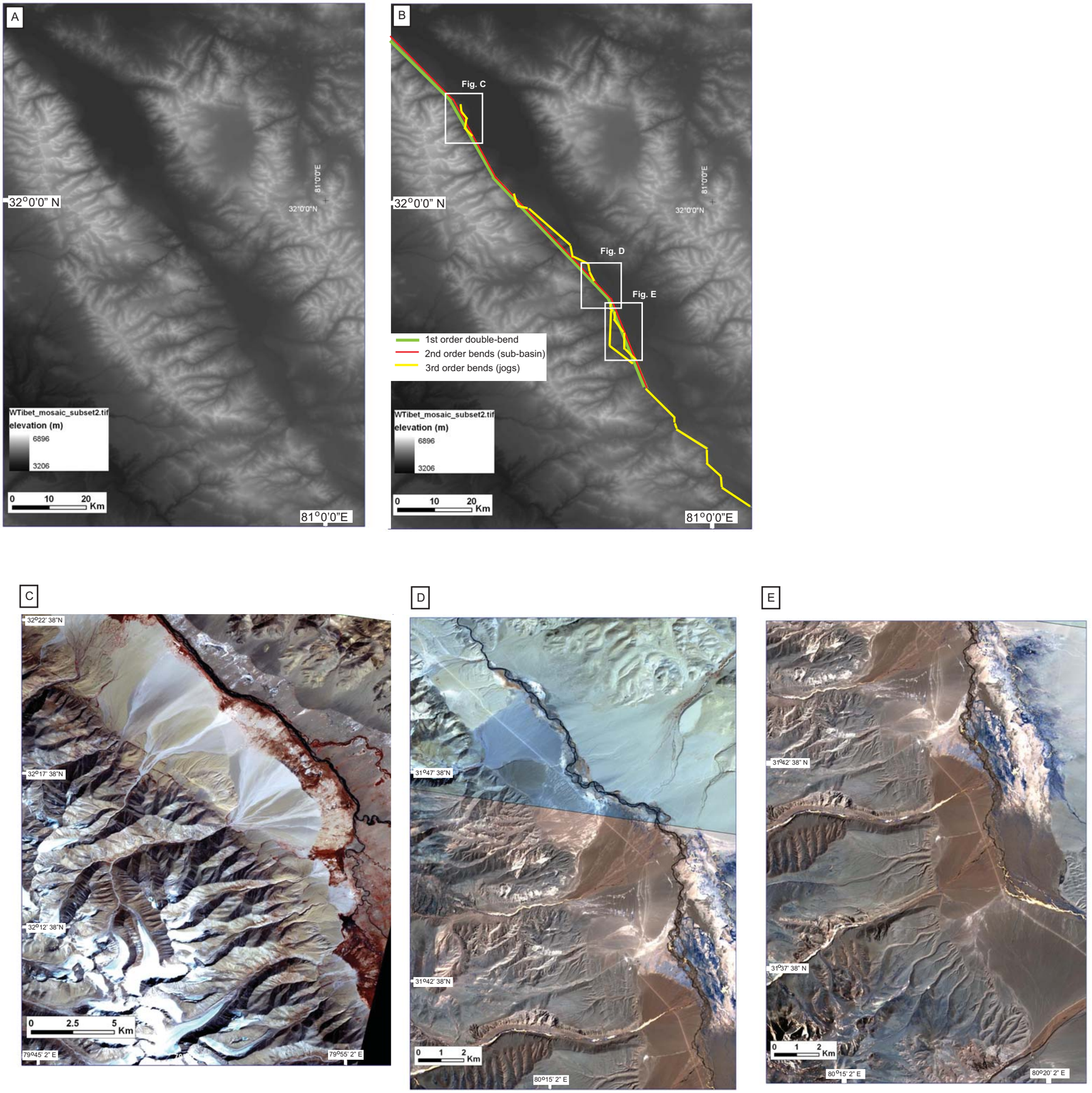
Figure DR-3. Conglomerate clast counts and compositions for various locations in Tcg2. Location is in parentheses according to measuring station. For clast count locations, see Figure DR6.

Figure DR-4. Conglomerate clast counts and compositions for various locations in Tcg3. Location is in parentheses according to measuring station. For clast count locations, see Figure DR6.

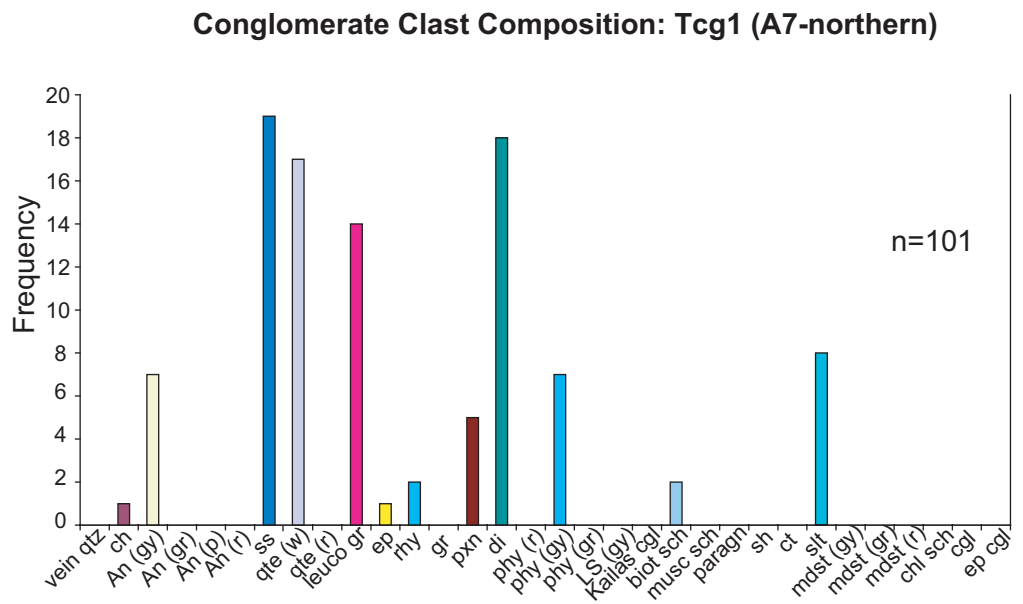
Figure DR-5. Conglomerate clast counts and compositions for various locations in Tcg4. Location is in parentheses according to measuring station. For clast count locations, see Figure DR6.

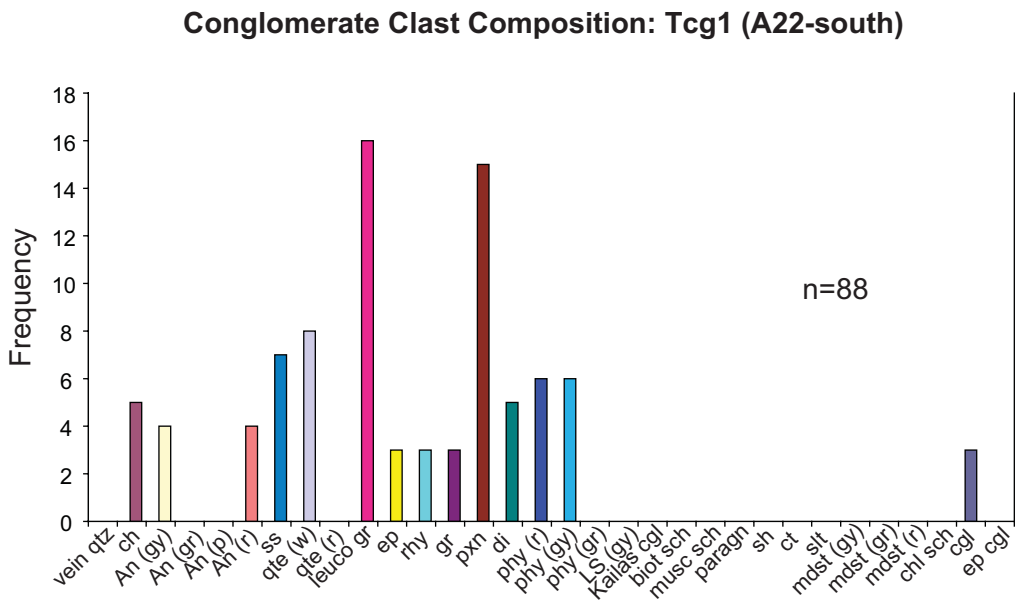
Figure DR-6. Conglomerate clast counts and compositions for various locations in Tcg5. Location is in parentheses according to measuring station. For clast count locations, see Figure DR6.

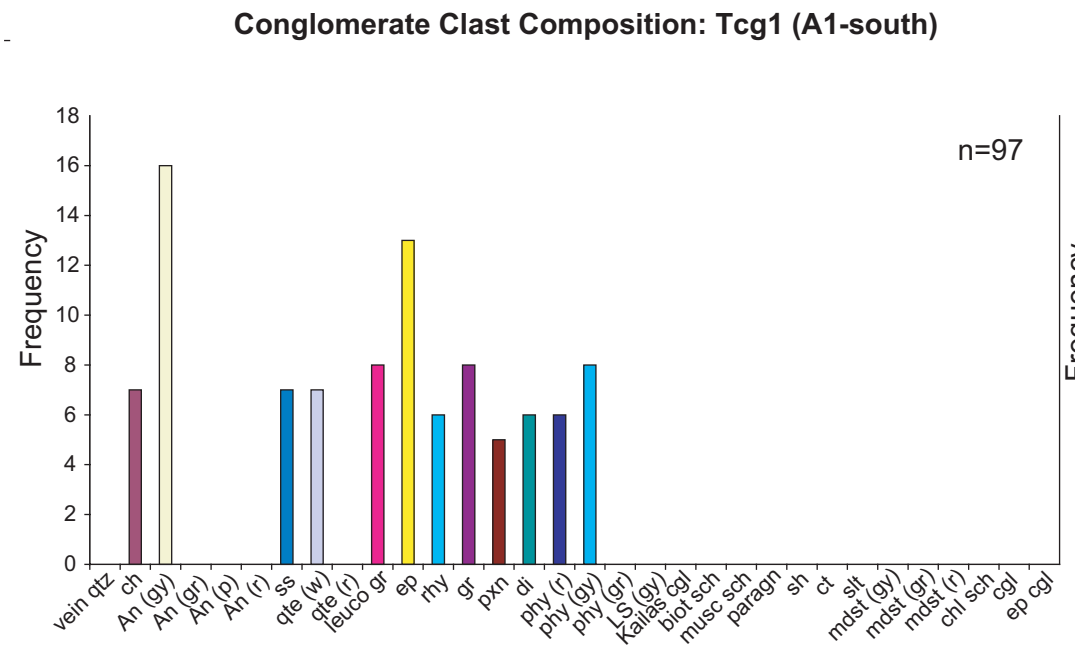
Figure DR-7. Clast count location map. Locations for clast counts are indicated by red circles with site number next to it.

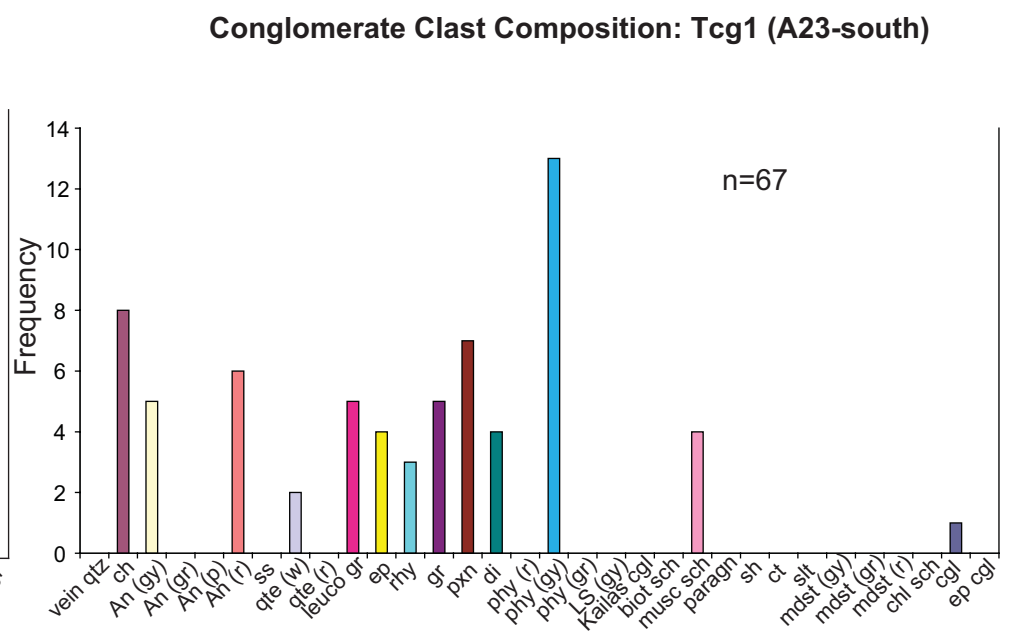


Veronica Sanchez, Figure DR-1, FigureDR1.ai

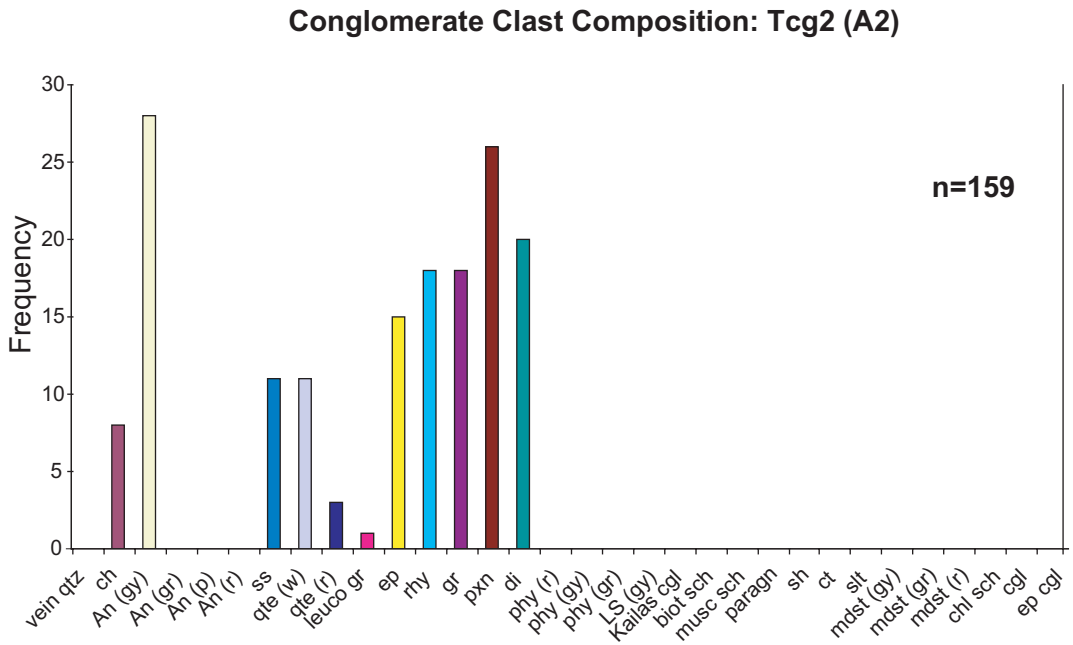


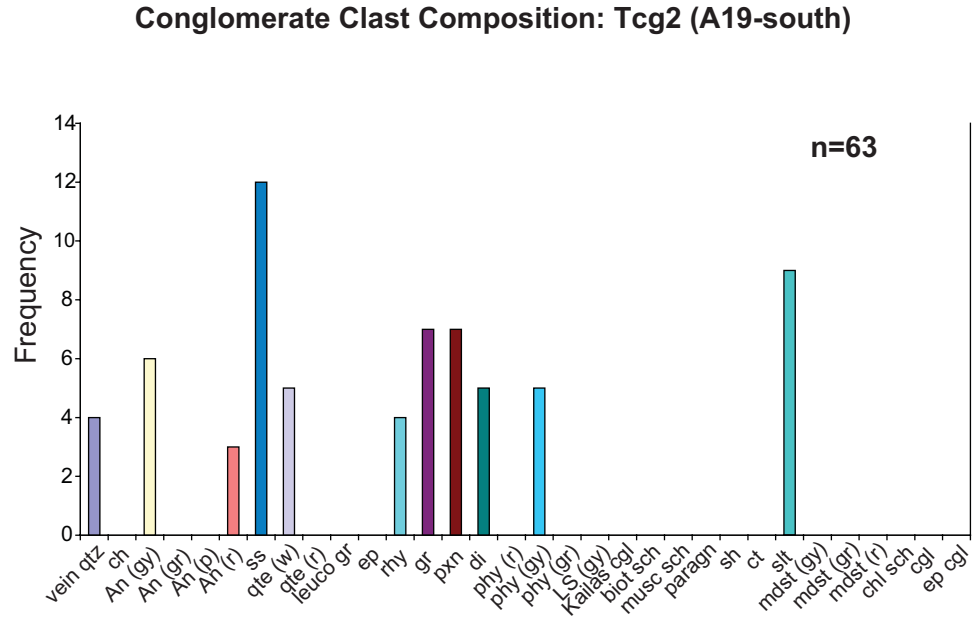


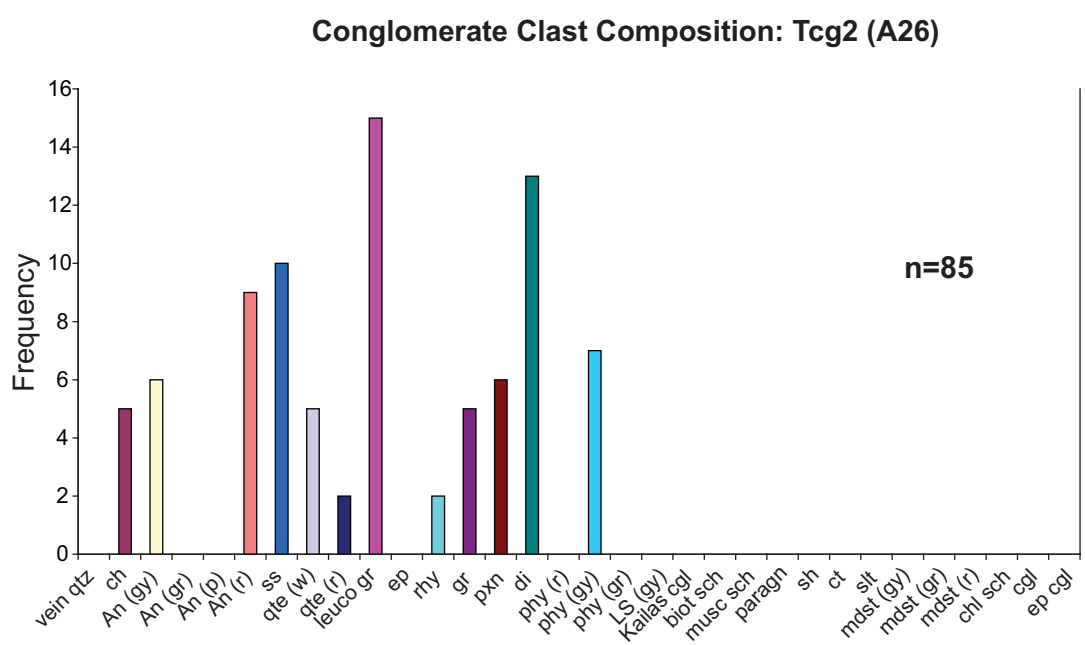


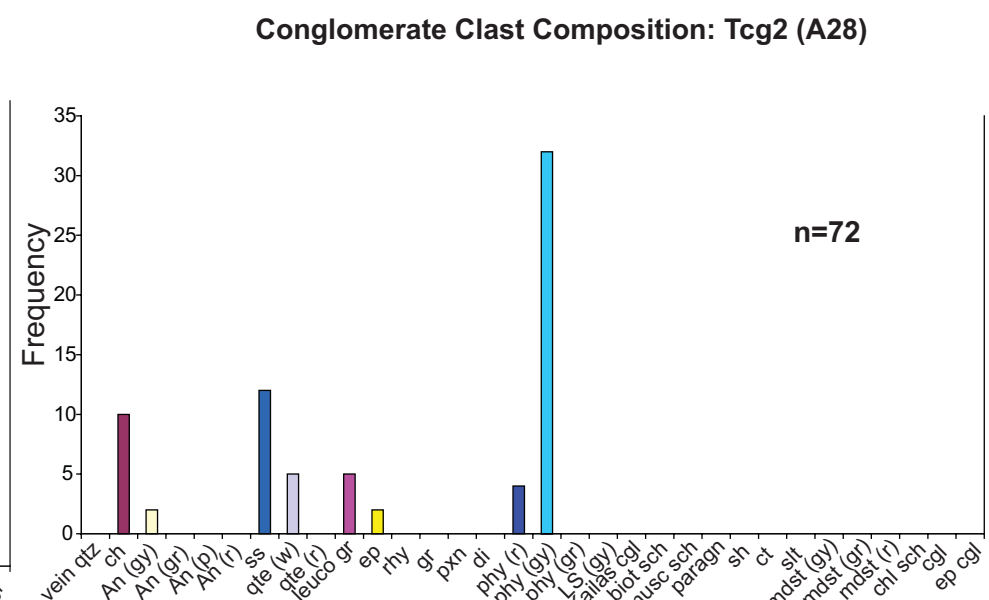


Veronica Sanchez, Figure DR-2, FigureDR2.ai

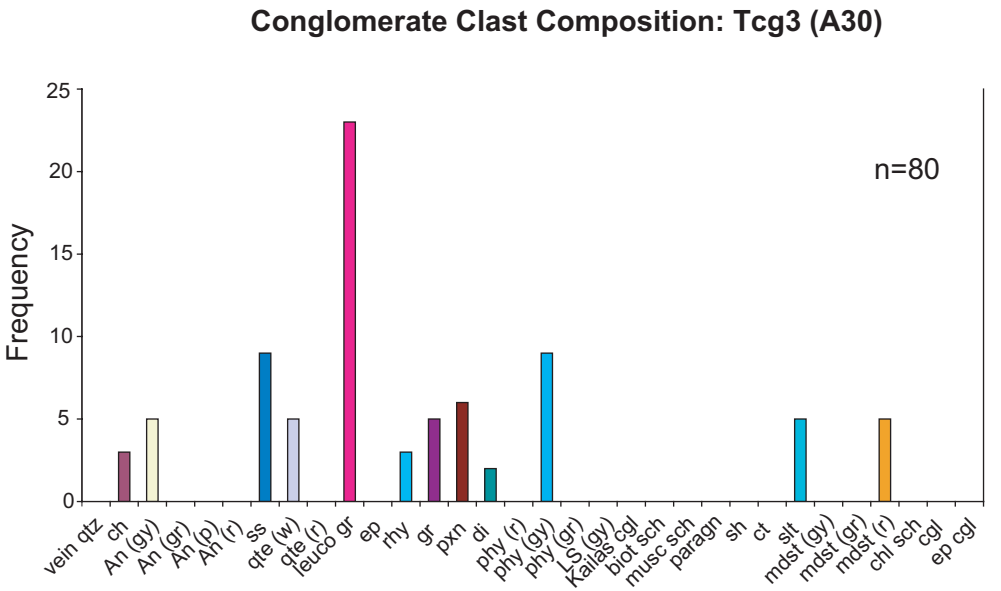


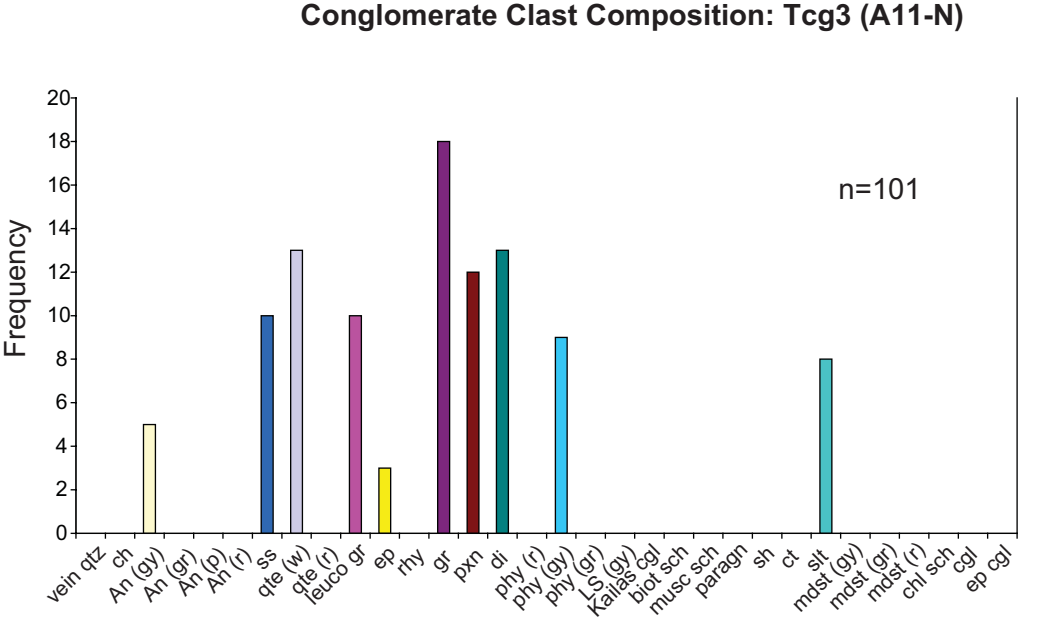


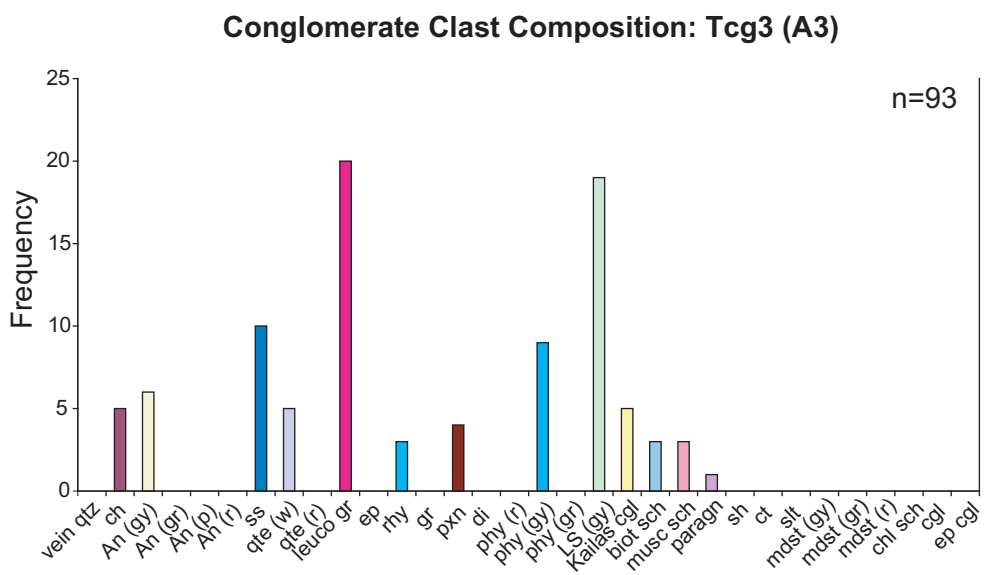


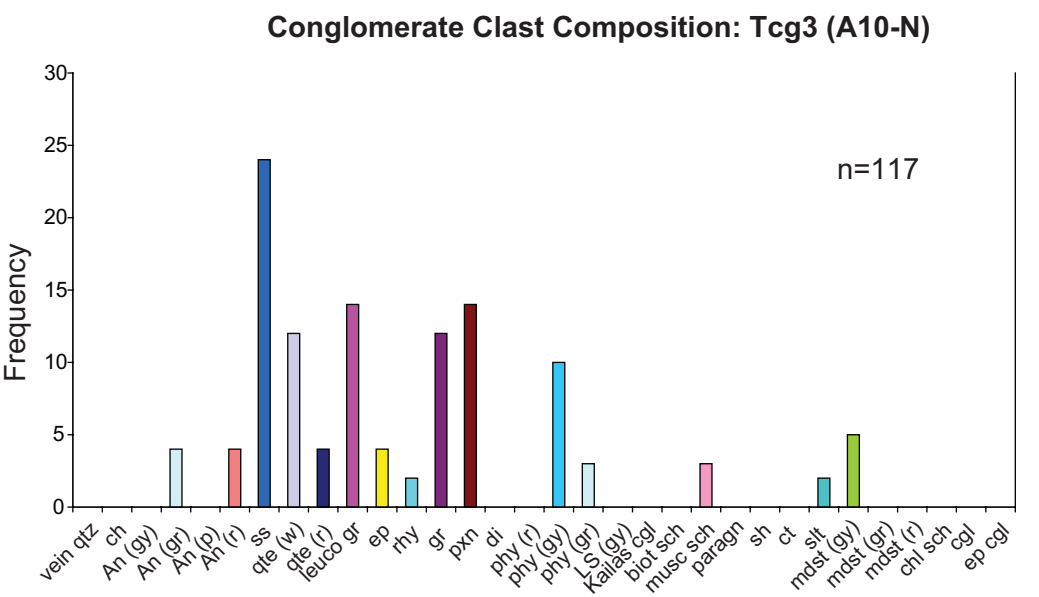


Veronica Sanchez, Figure DR-3, FigureDR3.ai

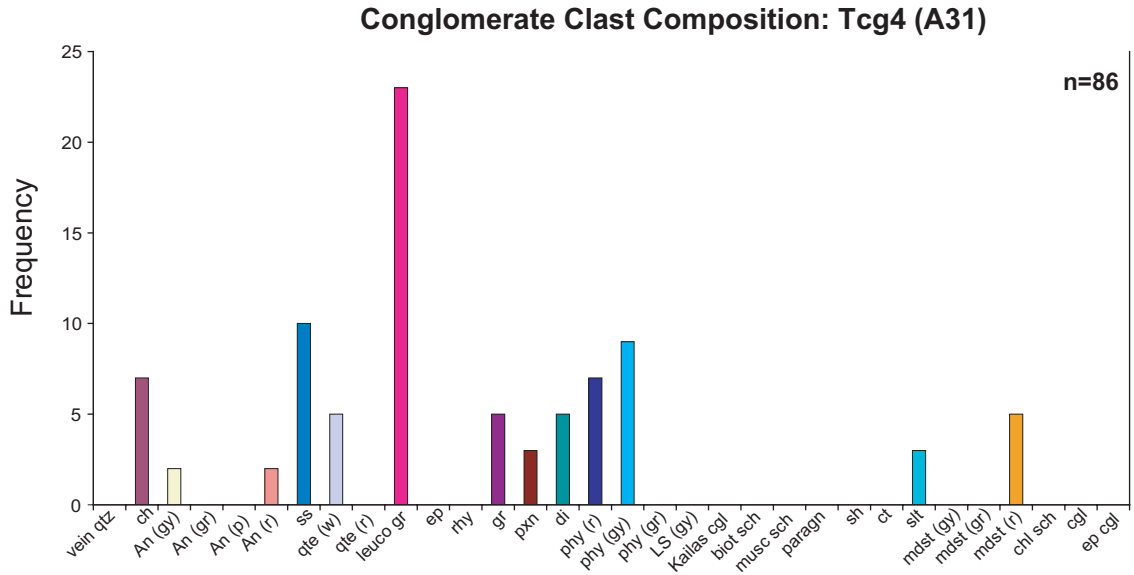


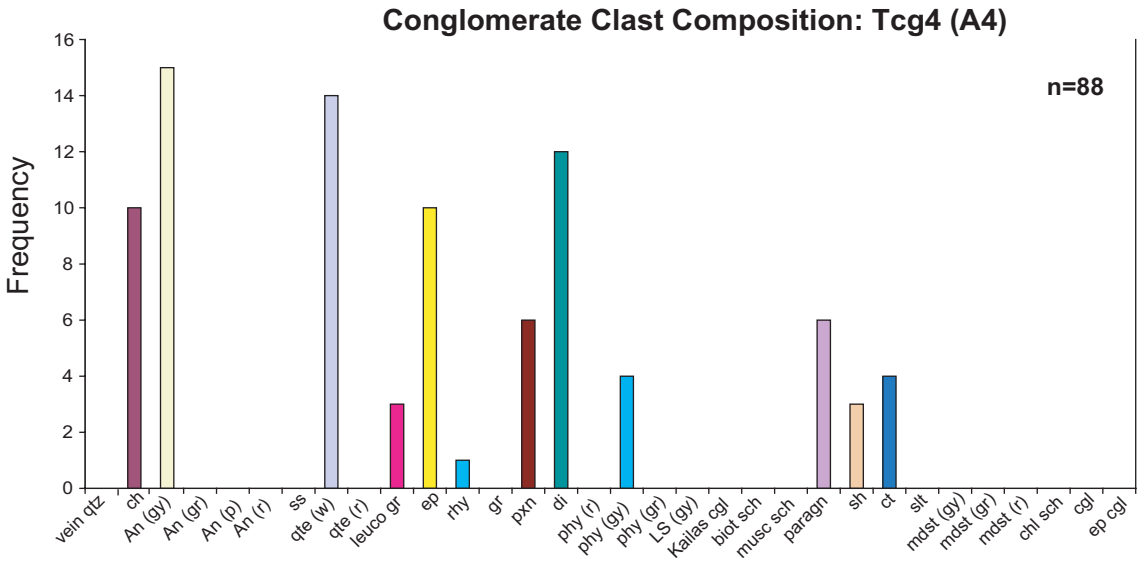




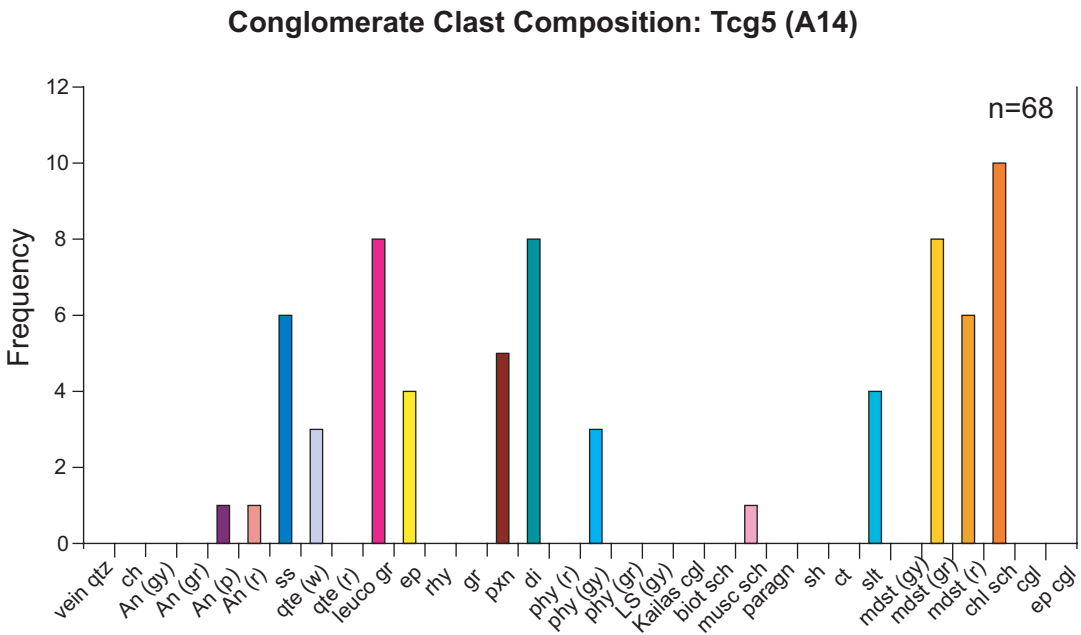


Veronica Sanchez, Figure DR-4, FigureDR4.ai

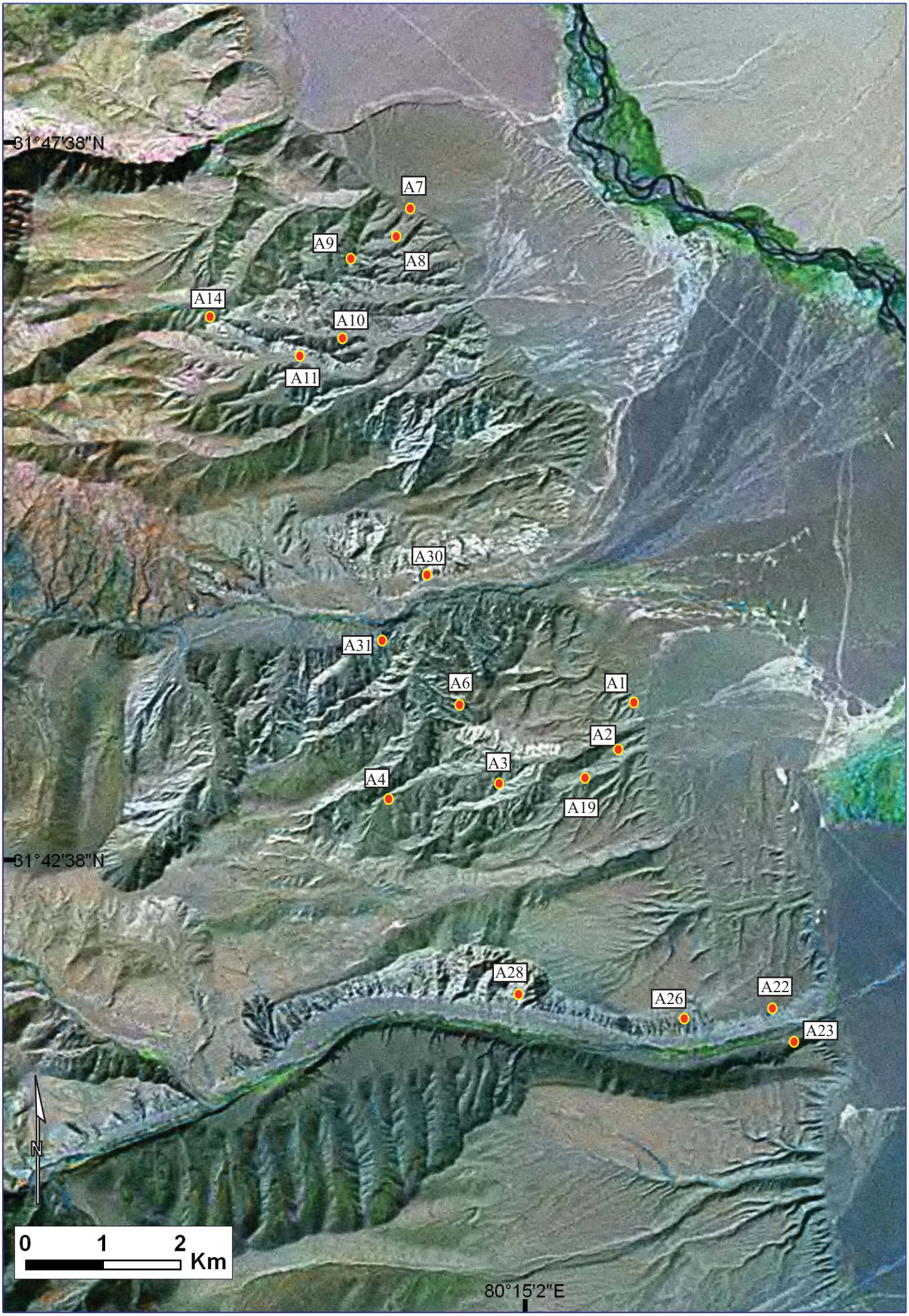




Veronica Sanchez, Figure DR-5, FigureDR5.ai



Veronica Sanchez, Figure DR-6, FigureDR6.ai



Veronica Sanchez, FigureDR-7, FigureDR7.ai