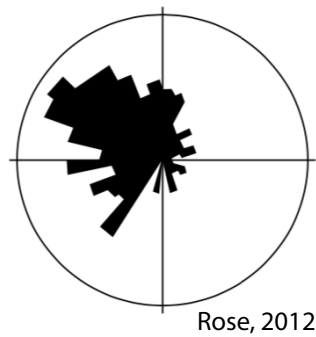


A. Tapeats (Northern Arizona)

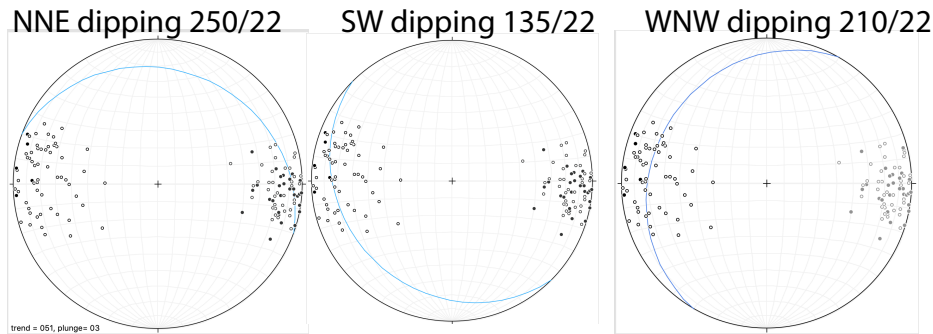
i.



Rose, 2012

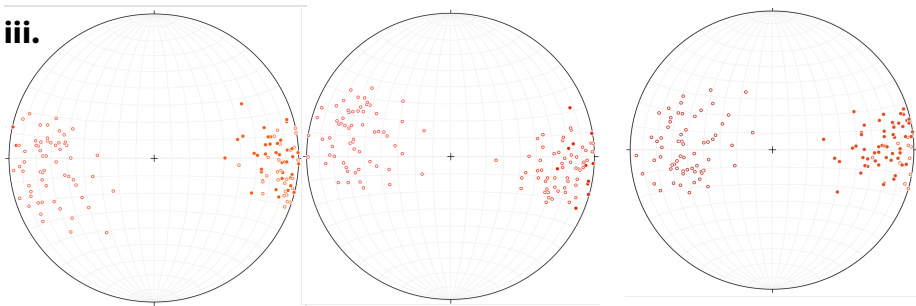
ii.

Tilt-corrected paleomagnetic directions with illustrative cross-bedding plane(blue)

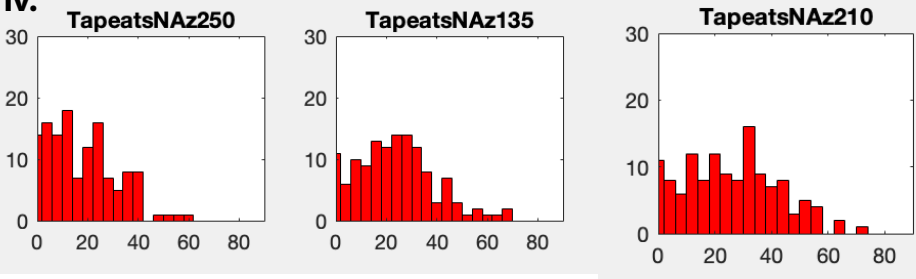


Elston and Bressler, 1977 paleomagnetic directions

iii.



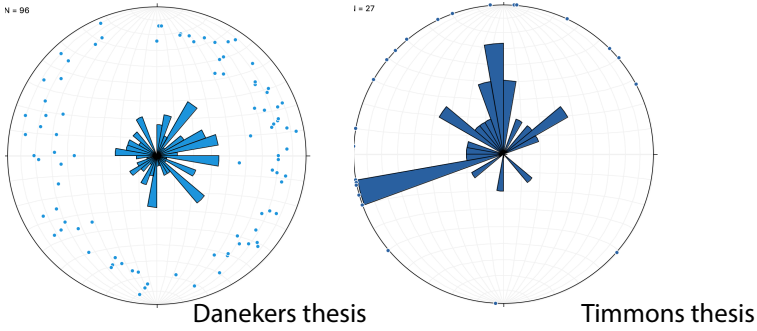
iv.



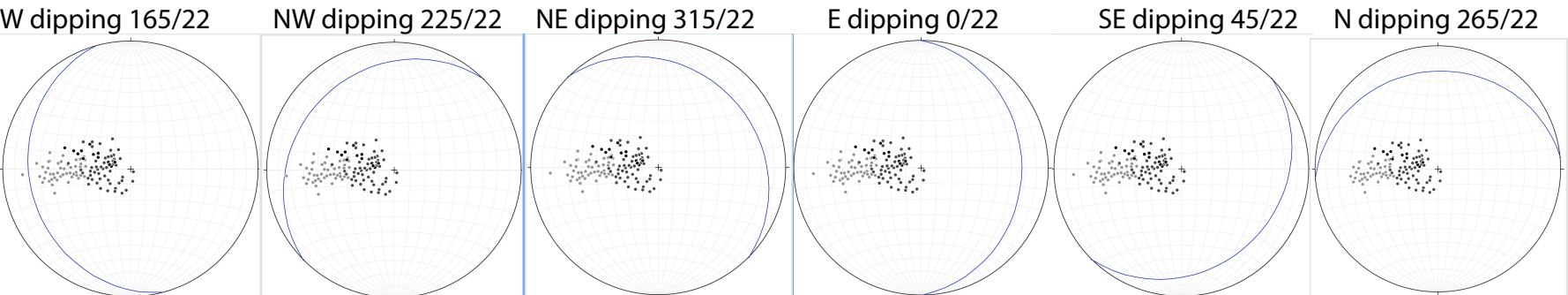
B. Shinumo (Grand Canyon)

i.

Cross-bedding dip direction/dip and rose diagram

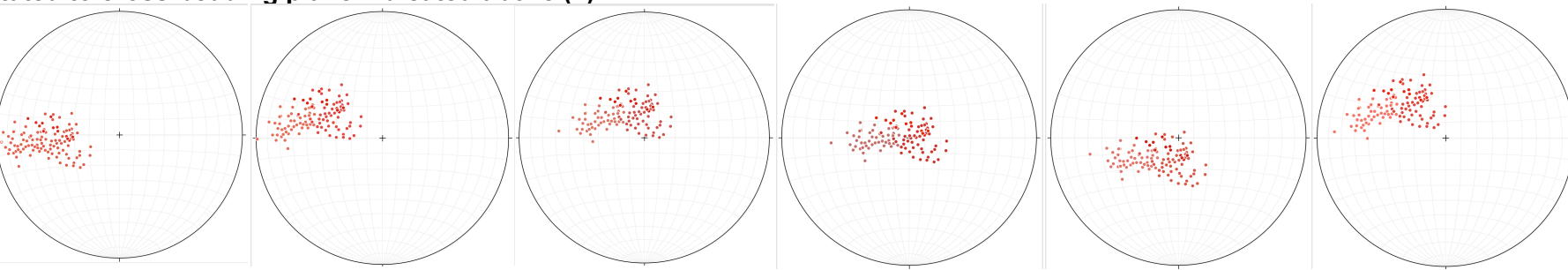


ii.



Elston and Gromme, 1994 paleomagnetic directions

iii.



iv.

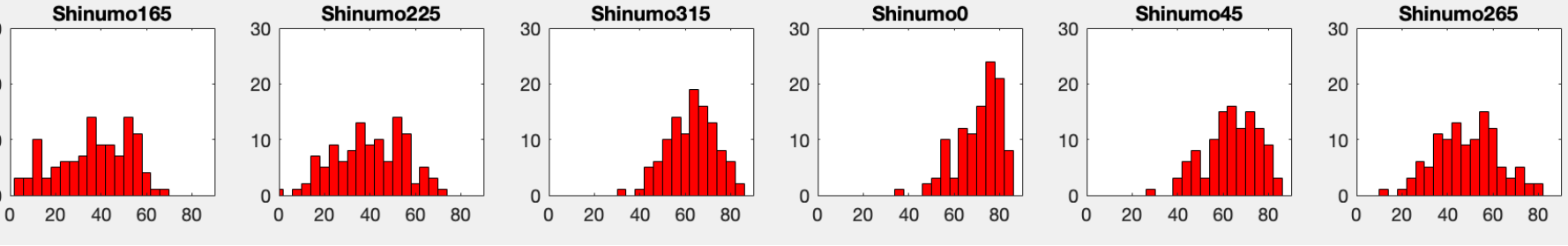


Table S1: Rotations of measured paleomagnetic paleopoles to test the error introduced by measuring inclinations relative to cross bedding of different orientations instead of horizontal bedding.