Kinematics and Timing of Deformation of Nellis Dunes Recreational Area, Nevada*

Shaimaa Abdelhaleem¹ and Wanda J. Taylor¹

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¹Geoscience Department, University of Nevada, Las Vegas, Las Vegas, NV, USA (shimo_imagination@hotmail.com)

Abstract

Kinematics and origin of transfer, accommodation and strike-slip zones is of paramount significance in understanding the kinematic models of continental extension. The Las Vegas Valley Shear Zone (LVVSZ) is a NW-striking right-lateral fault system in the central Basin and Range province. Despite its prominence among the structures of the region and its role in the regional tectonic development, little is understood about its eastern portion. Nellis Dunes Recreational Area (NDRA), north of Frenchman Mountain, lies along the eastern part of LVVSZ. The area exposes structures, the Muddy Creek Formation and Quaternary deposits. Previous mapping suggested that the area under the NDRA formed as a pull-apart basin between the LVVSZ in the northern part of the area and the Munition fault that lies to south and bounds the northern end of the Frenchman Mountain block. However, some structural geometries are inconsistent with the regional pull-apart basin model of Nellis basin. The purpose of this study is to collect and analyze more detailed data and suggest a deformation model consistent with the entire fold and fault geometries. Larger scale mapping (1:8,000) provided complex structural geometries and kinematics. Secondary NE-oriented folds are interpreted to be related to right-lateral strike-slip faults that dominate the northwestern and northeastern parts of NDRA, while the central part is dominated by NW-oriented folds with NE-striking normal faults. Structural analysis showed that area exhibits three different strains. The right-lateral faults are part of the LVVSZ and cut Muddy Creek Formation suggesting that the LVVSZ was active after 4.7 Ma. Later, during the Quaternary, the LVVSZ was cut by NE-oriented left-lateral strike-slip faults with associated folds consistent with the recent NE strain direction. The northern end of Frenchman Mountain fault curves to the NE forming a left-lateral fault splay in the southern part of NDRA. Consequently, NE-striking faults and NW-oriented folds dominated the southern part of NDRA as secondary structures associated with that left-lateral deformation.

Selected References


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Shaimaa Abdelhaleem*, Wanda J. Taylor**

*Geoscience Department, University of Nevada, Las Vegas, Las Vegas, Nevada.
• Background: Las Vegas Valley Shear Zone
• Study Area: NDRA
• Problem
• Methods
• Results
• Conclusion

Contents
- McLaurin et al. (2011)
- Buck et al. (2011)
- Goossens et al. (2008)
- Beard et al. (2007)
- Ekren (1968)
- GSA Memoir 110 - Two papers

NDRA

UNLV
NDRA

Stratigraphy

Age range 8.5 - <4.7 Ma

NDRA

Tuff (4.7 Ma)

Brett Maclaurin, UBP
Louis Oppenheim

UNLV
Different Maps?!

Beard et al. (2007)

Anderson and Beard (2010)
Surprise!
Right-Lateral?  LVVSZ?
So we decided ....
What did we find?
What did we find?
What did we find?
What did we find?
What did we find?
Domain A

Background

Study Area

Problem

Methods

Results

Conclusion

NW-Extensional Structures

ENE to NE-Compressional Structures
Domain A

Background

Study Area

Problem

Methods

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Conclusion

NW-Extensional Structures

ENE to NE-Compressional Structures

LVVSZ Orientation
Domain A

Study Area

LVVSZ Orientation

Background

Problem

Methods

Results

Conclusion

EPE to NE-Compressional Structures

NW-Extensional Structures
Domain A

Study Area:
- NW-Extensional Structures
- ENE to NE-Compressional Structures
- LVVSZ Orientation
Domain B

NE-Extensional Structures

NW-Compressional Structures
Domain B

NE-Extensional Structures

NW-Compressional Structures
Quaternary Faults

Faulds and Varga, (1998)

NDRA

UNLV
Domain B

NE-Extensional Structures

NW-Compressional Structures

Left-Lateral Accomodation ZoneZ
Domain C
Domain C
• NDRA is deformed by three deformations rather than LVVSZ only
  • LVVSZ developed through the NW part and stopped moving before Quaternary.
  • During Quaternary, an ENE-oriented accommodation zone has developed through the central part overprinting LVVSZ.
  • FMF terminates in the southern part forming a horsetail splay later than LVVSZ.
Thank You
To test kinematic compatibility, analyses are done that include fault slip sense, fault strike, fold orientation plotted on stereographs and fence diagrams / 3D models.

Structures are kinematically compatible if:

1. They formed during to the same deformational episode, and
2. Yield single stress (shortening or extensional) axes.
Strike-Slip Deformation

Sylvester (1988)
Strike-Slip Deformation