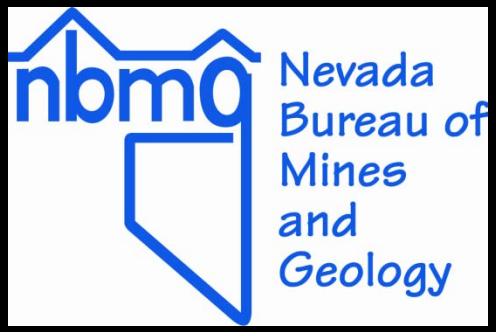
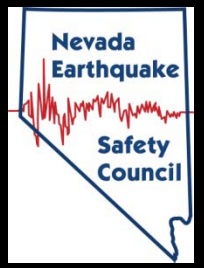
Earthquake Hazards in Pershing County

Presentation to the Nevada Hazard Mitigation Planning Committee
26 August 2010
by Jonathan G. Price
Nevada Bureau of Mines and Geology

Earthquake faults occur throughout Nevada, and potential losses from earthquakes are high for many communities.





Earthquake faults occur throughout Nevada, and potential losses from earthquakes are high for many communities.

NBMG Map 167, *Quaternary Faults in Nevada*, is now available not only as a poster but also as an interactive map (Open-File Report 09-9) on line at www.nbmg.unr.edu. You can use it to locate your home or business.

Nevada Bureau of Mines and Geology

University of Nevada, Reno
Statewide • Worldwide

FEMA

Nevada Department of Public Safety
Division of Emergency Management

Nevada Earthquake Safety Council

USGS
science for a changing world

NEVADA Seismological Laboratory

THE GREAT SEAL OF THE STATE OF NEVADA
ALL FOR OUR COUNTRY

Age of Latest Fault Rupture

< 150 years (historical)

< 15,000 years

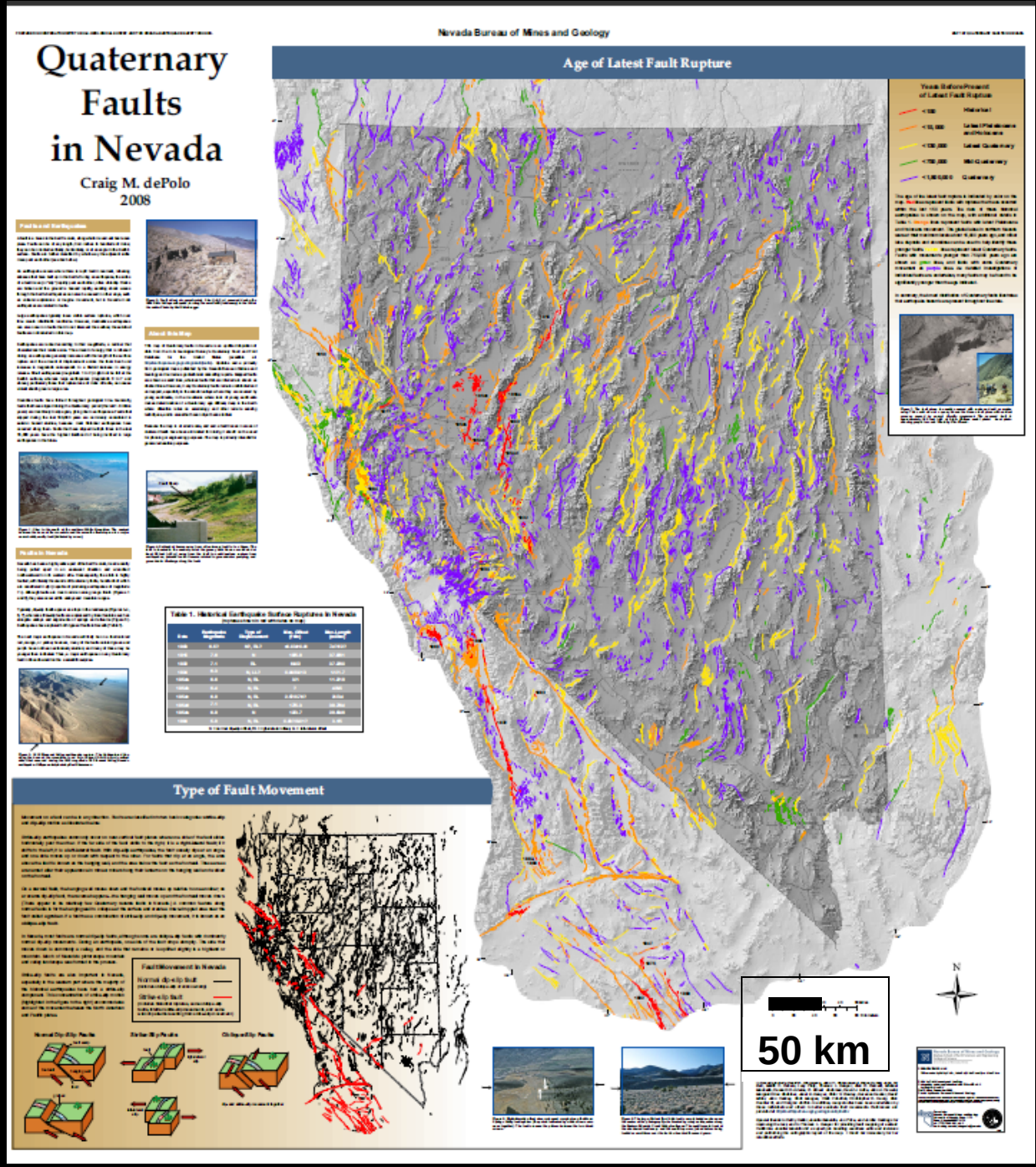
< 130,000 years

< 750,000 years

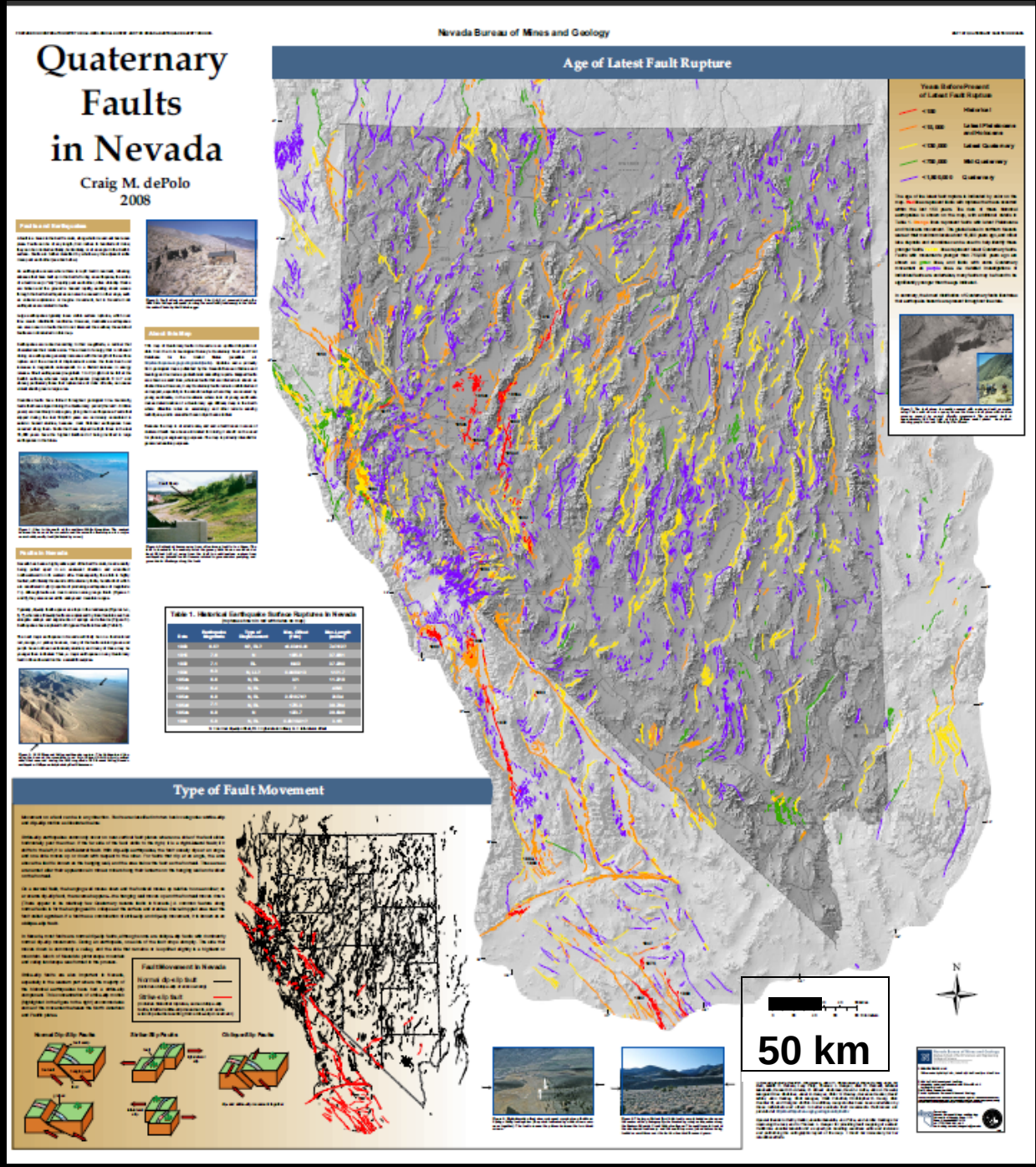
< 1,800,000 years (Quaternary)

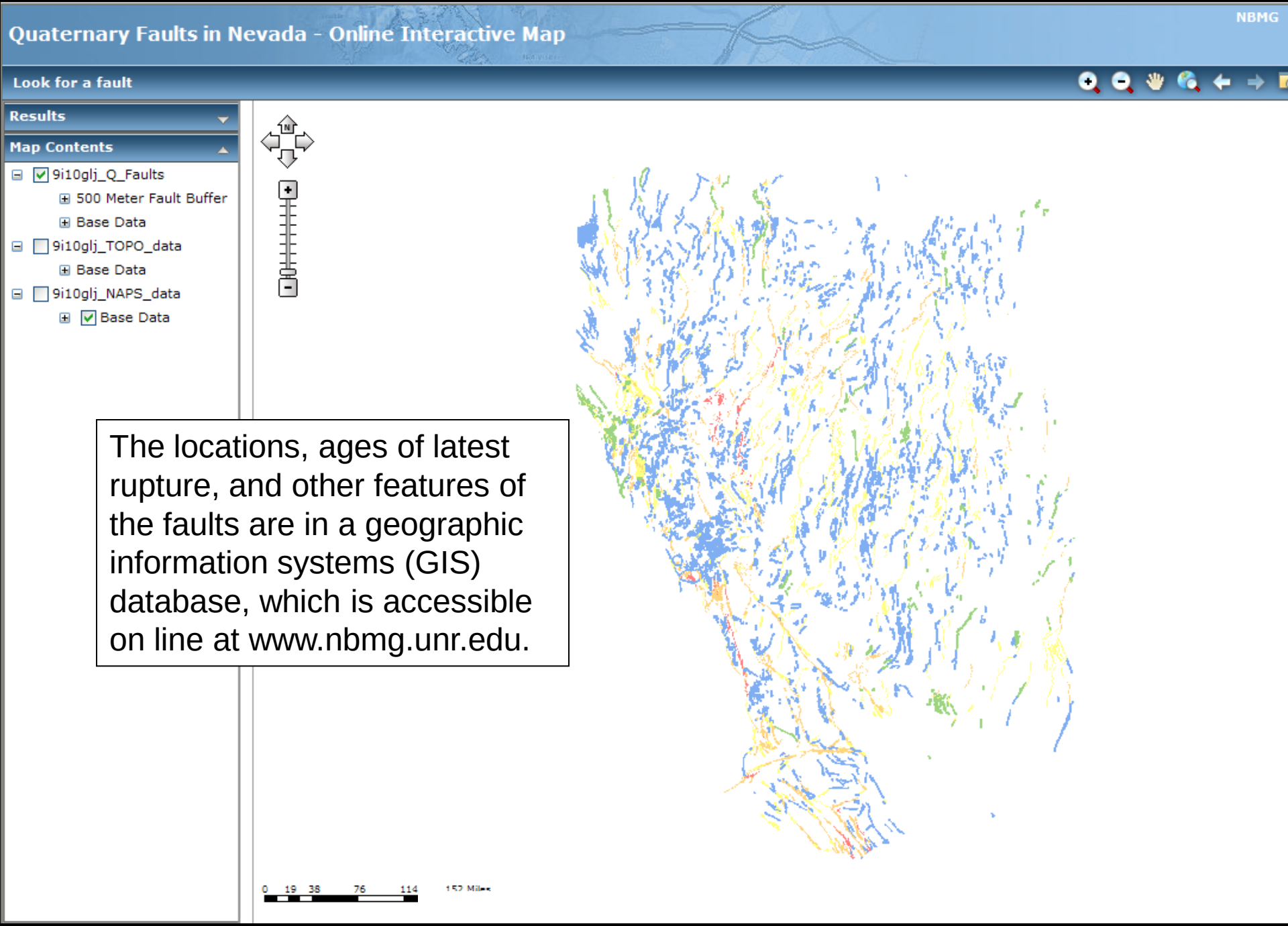
There are active faults nearly everywhere in Nevada. A magnitude 6.0 earthquake can occur anywhere in Nevada.

www.nbmg.unr.edu



The map has ~130 major faults (with lengths >19 miles or 30 km), ~300 intermediate faults with lengths of 6-19 miles (10-30 km), and >1,150 smaller faults. Surface breakage typically occurs when an earthquake is greater than or equal to magnitude 6.5.




Quaternary Faults in Nevada - Online Interactive Map
NBMG
Look for a fault
Results
Map Contents
9i10glj_Q_Faults
500 Meter Fault Buffer
Base Data
9i10glj_TOPO_data
Base Data
9i10glj_NAPS_data
Base Data
The locations, ages of latest rupture, and other features of the faults are in a geographic information systems (GIS) database, which is accessible on line at www.nbmg.unr.edu.
0 19 38 76 114

http://gisweb.unr.edu/OF09_9/

Quaternary Faluts in Nevada - Online Interactive Map

Easy to pinpoint an address

Look for a fault | Find an Address | Print a Map

Results

Map Contents

Quaternar

Qu

US

US

Find an Address

Street or Intersection: 820 6th Street

City: Lovelock

State: Nevada

ZIP:

Find

0 19 38 76 114 152 Miles

Copyright

http://gisweb.unr.edu/OF09_9/

Quaternary Faluts in Nevada - Online Interactive Map

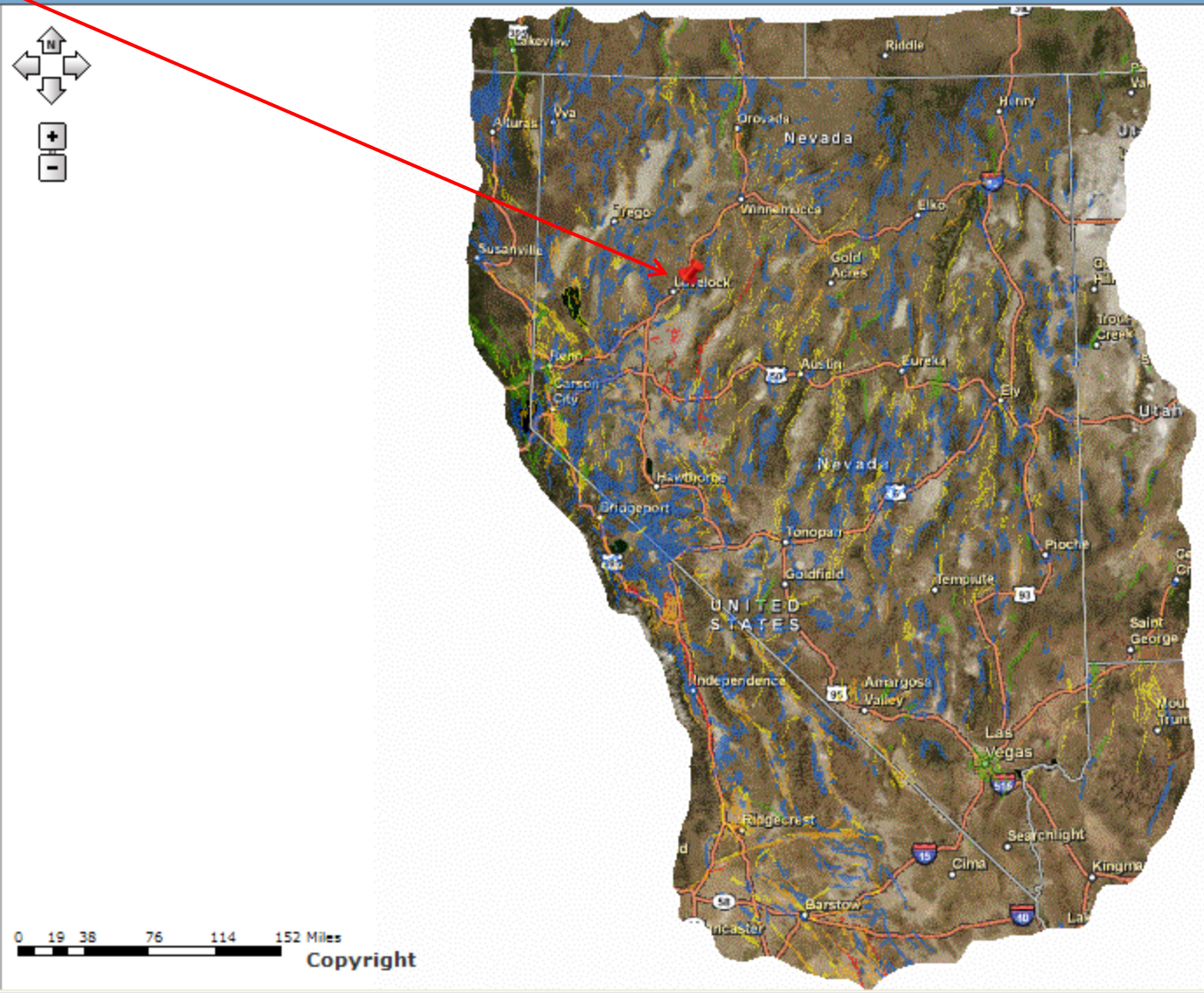
Look for a fault | Find an Address | Print a Map

Results

- 820 6th Street, Lovelock, Nevad
  - 820 6th St, Lovelock, NV, 89419

Map Contents

- Quaternary_Faults2
  - Quaternary Faults
  - USGS Topo Maps
  - USGS Aerial Imagery



http://mail.yahoo.com/?.refer=slv&.intl=us

http://gisweb.unr.edu/OF09_9/

Quaternary Faluts in Nevada - Online Interactive Map

Easy to zoom in on an address

Look for a fault | Find an Address | Print a Map

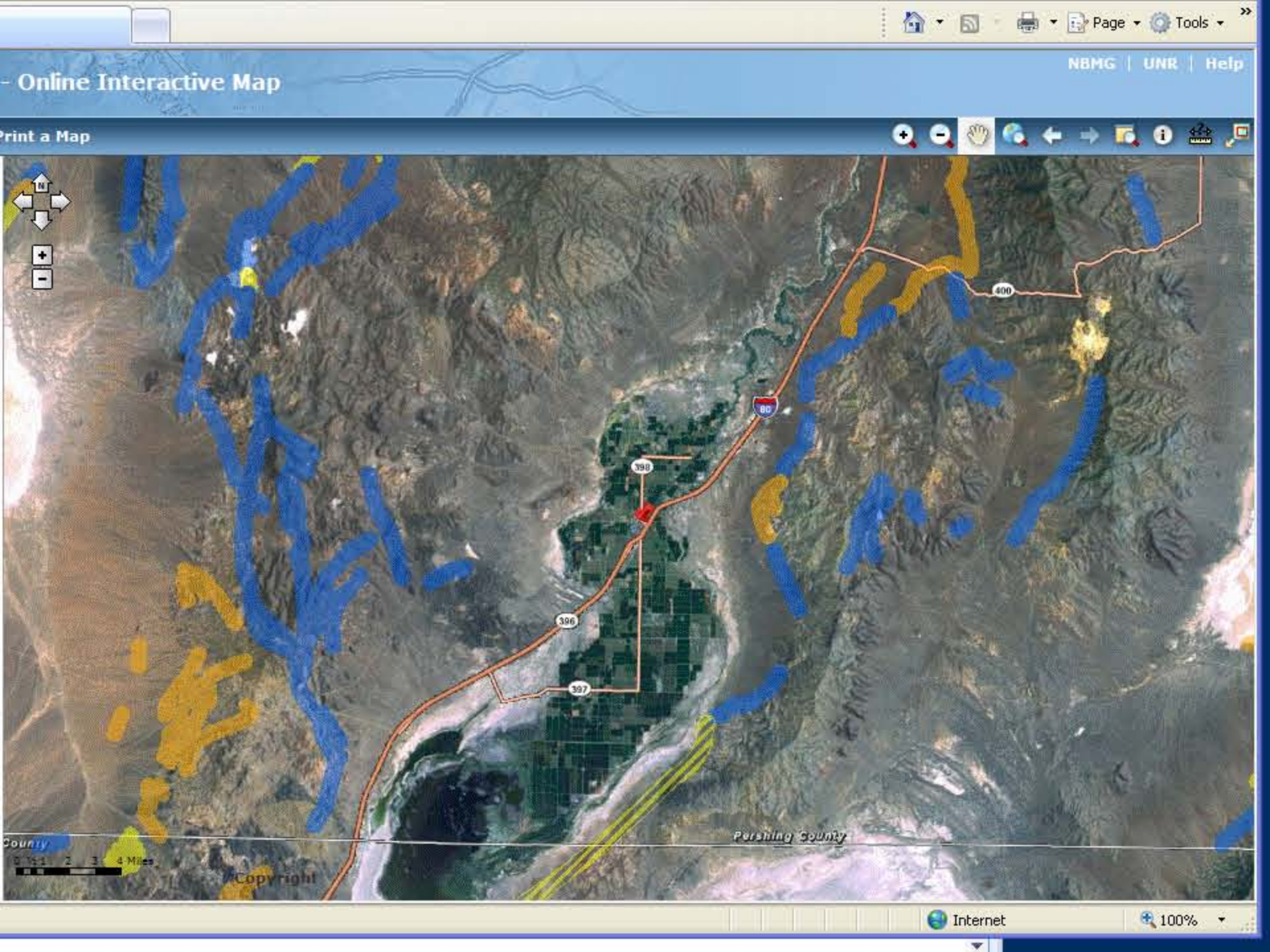
Results

- 820 6th Street, Lovelock, Nevad
  - 820 6th St, Lovelock, NV, 89419
    - Zoom to
    - Pan to
    - Remove

Map Contents

- Quaternary_Faults2
  - Quaternary Faults
  - USGS Topo Maps
  - USGS Aerial Imagery

0 19 38 76 114 152 Miles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NBMG | UNR | Help
- Online Interactive Map
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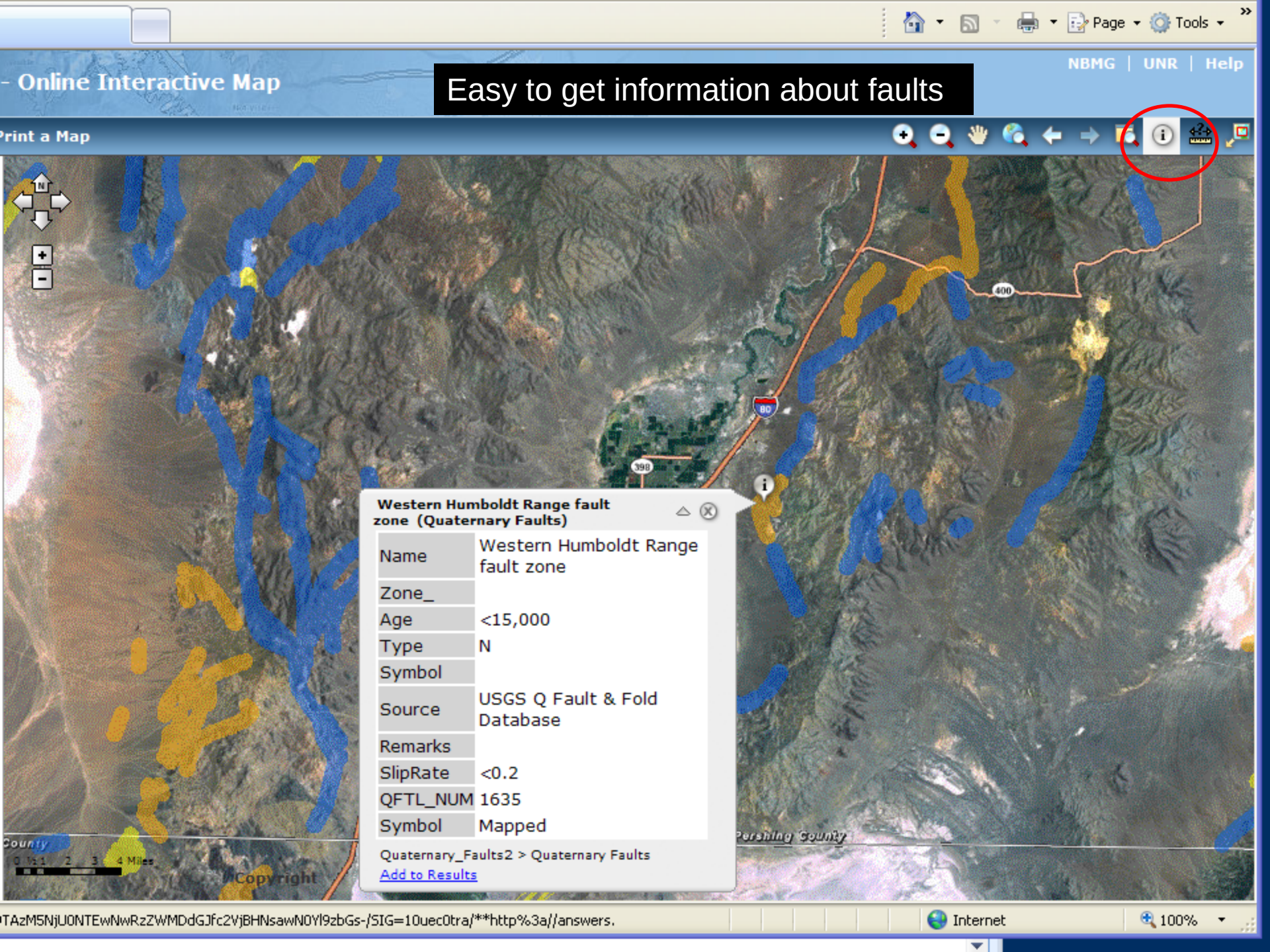
- Online Interactive Map
NBMG | UNR | Help
Easy to get information about faults
Print a Map
Western Humboldt Range fault zone (Quaternary Faults)
Name
Western Humboldt Range fault zone
Zone_
Age
<15,000
Type
N
Symbol
Source
USGS Q Fault & Fold Database
Remarks
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Quaternary_Faults2 > Quaternary Faults
Add to Results
Pershing County
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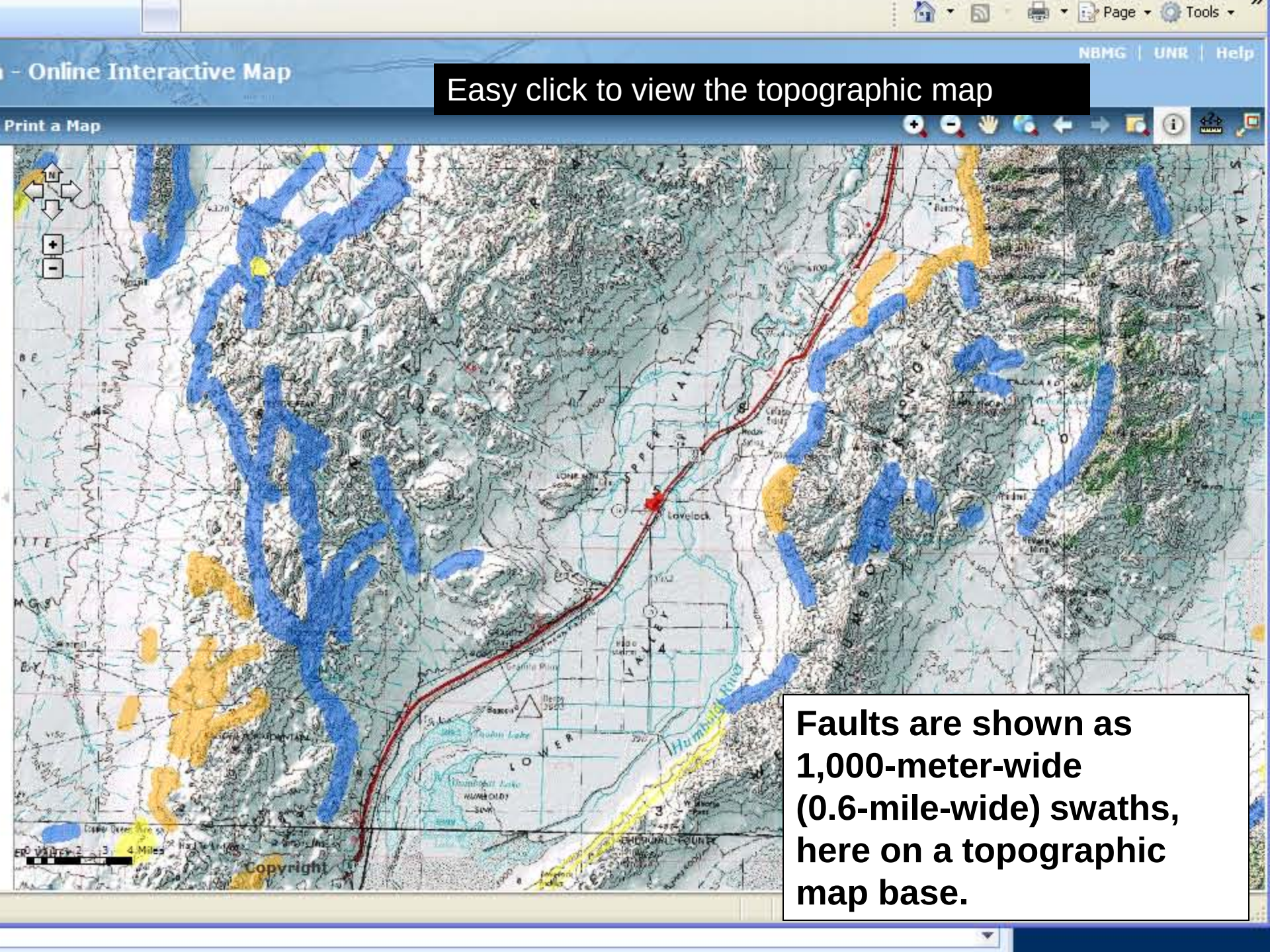
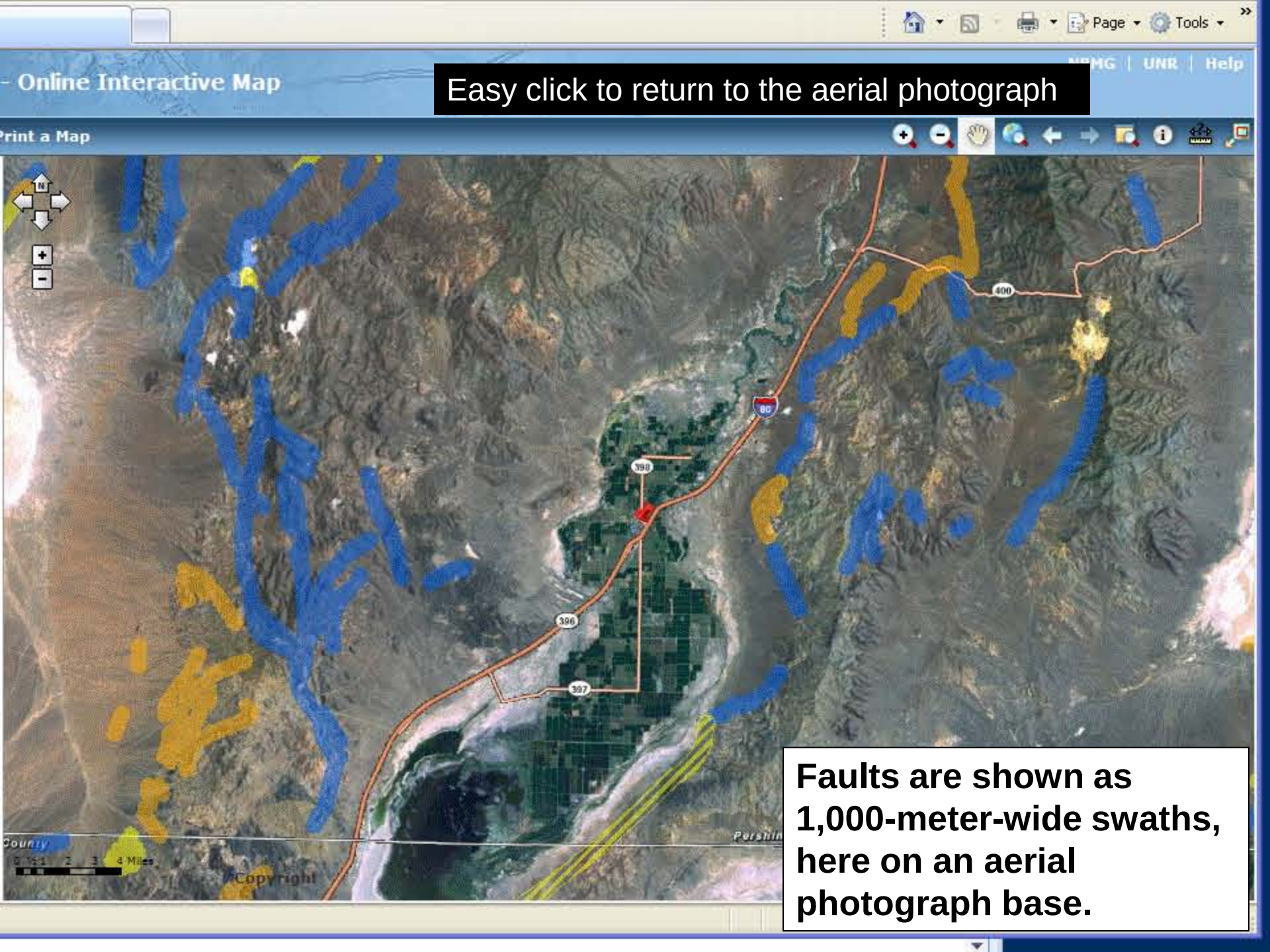

Page
Tools
NBMG | UNR | Help
- Online Interactive Map
Easy click to view the topographic map
Print a Map
Lovelock
Humboldt River
Copyright
Faults are shown as 1,000-meter-wide (0.6-mile-wide) swaths, here on a topographic map base.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UNR
Help
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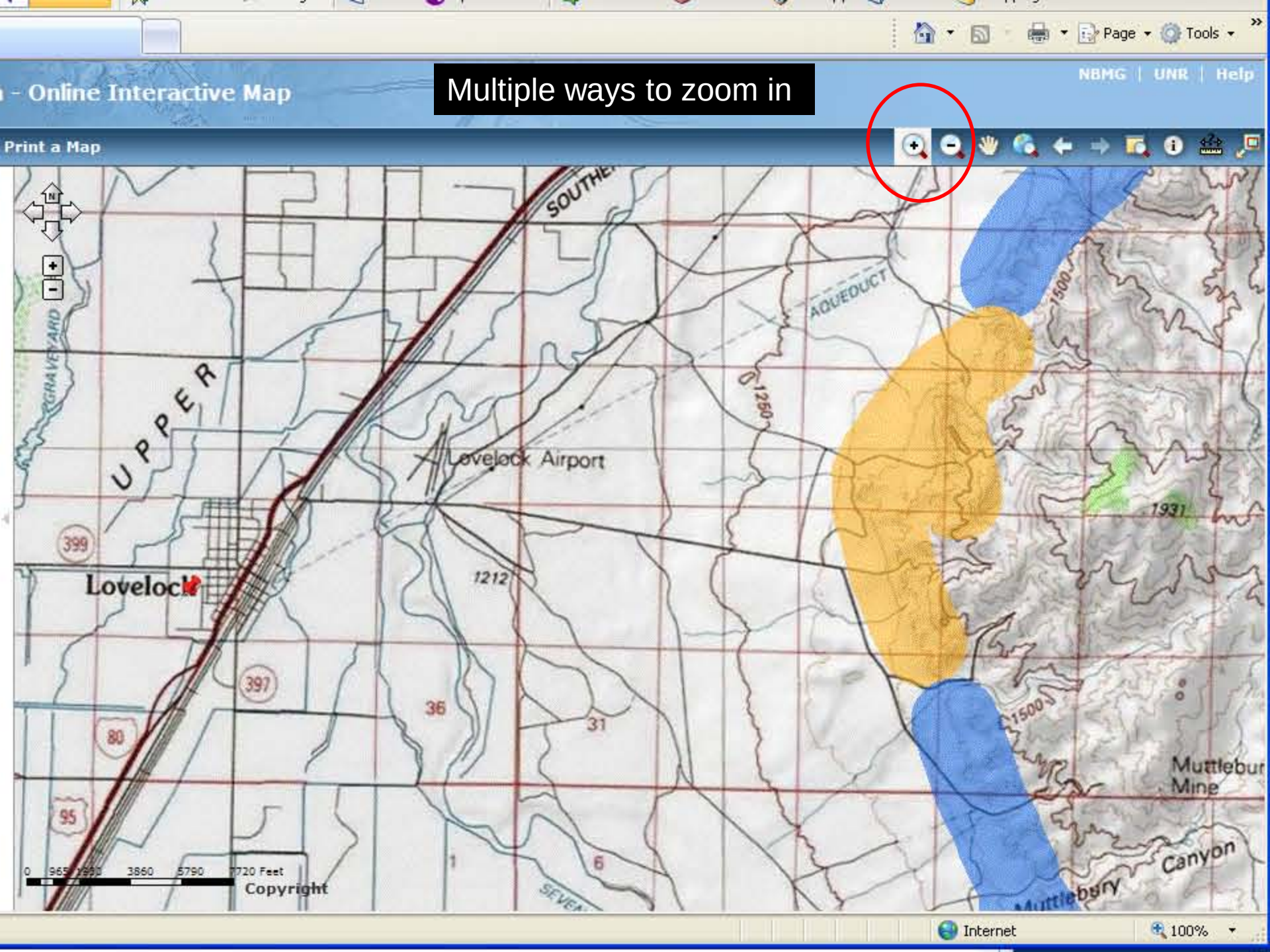
Faults are shown as 1,000-meter-wide swaths, here on an aerial photograph base.


Multiple ways to zoom in
- Online Interactive Map
NBMG | UNR | Help
Print a Map
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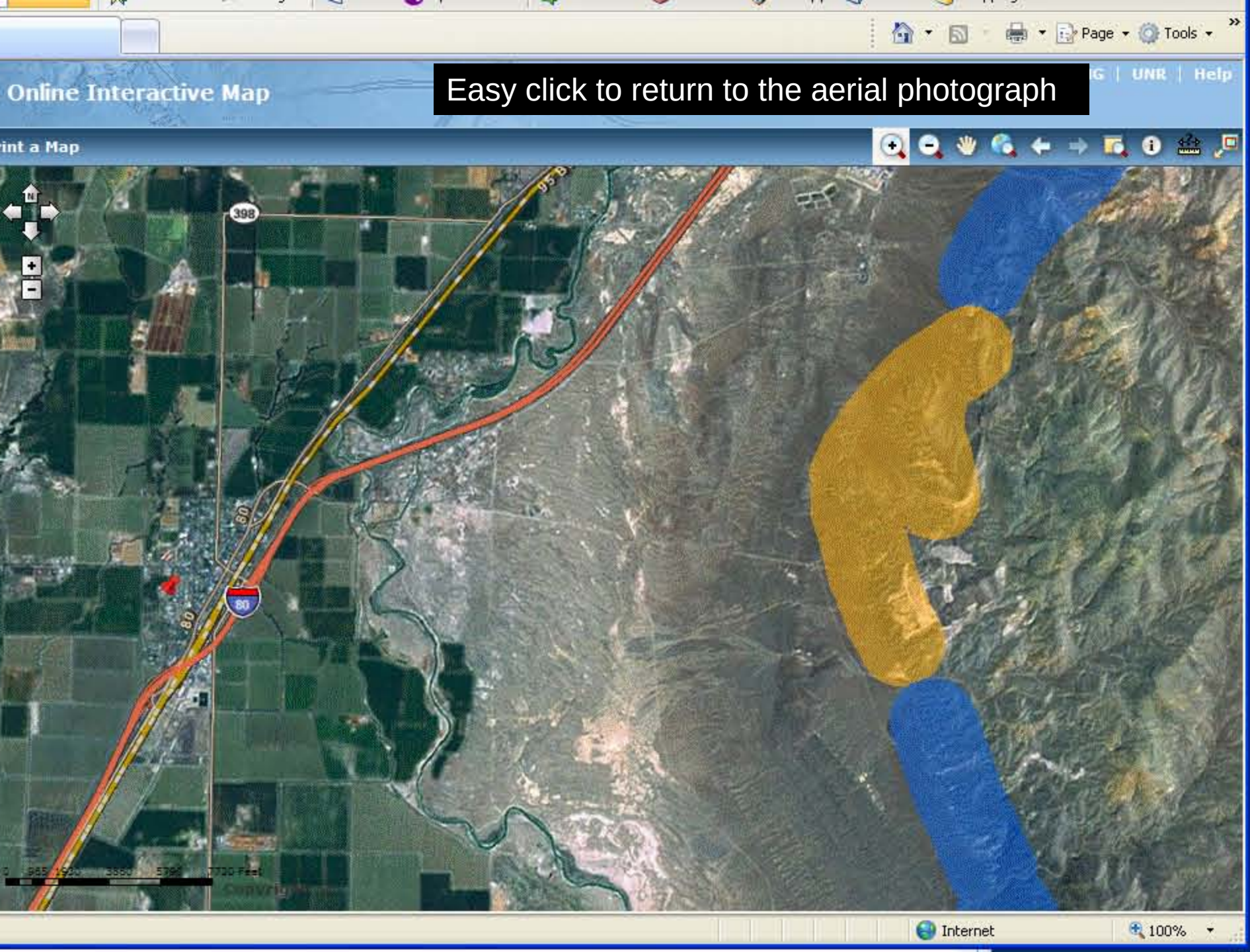
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Easy click to return to the aerial photograph
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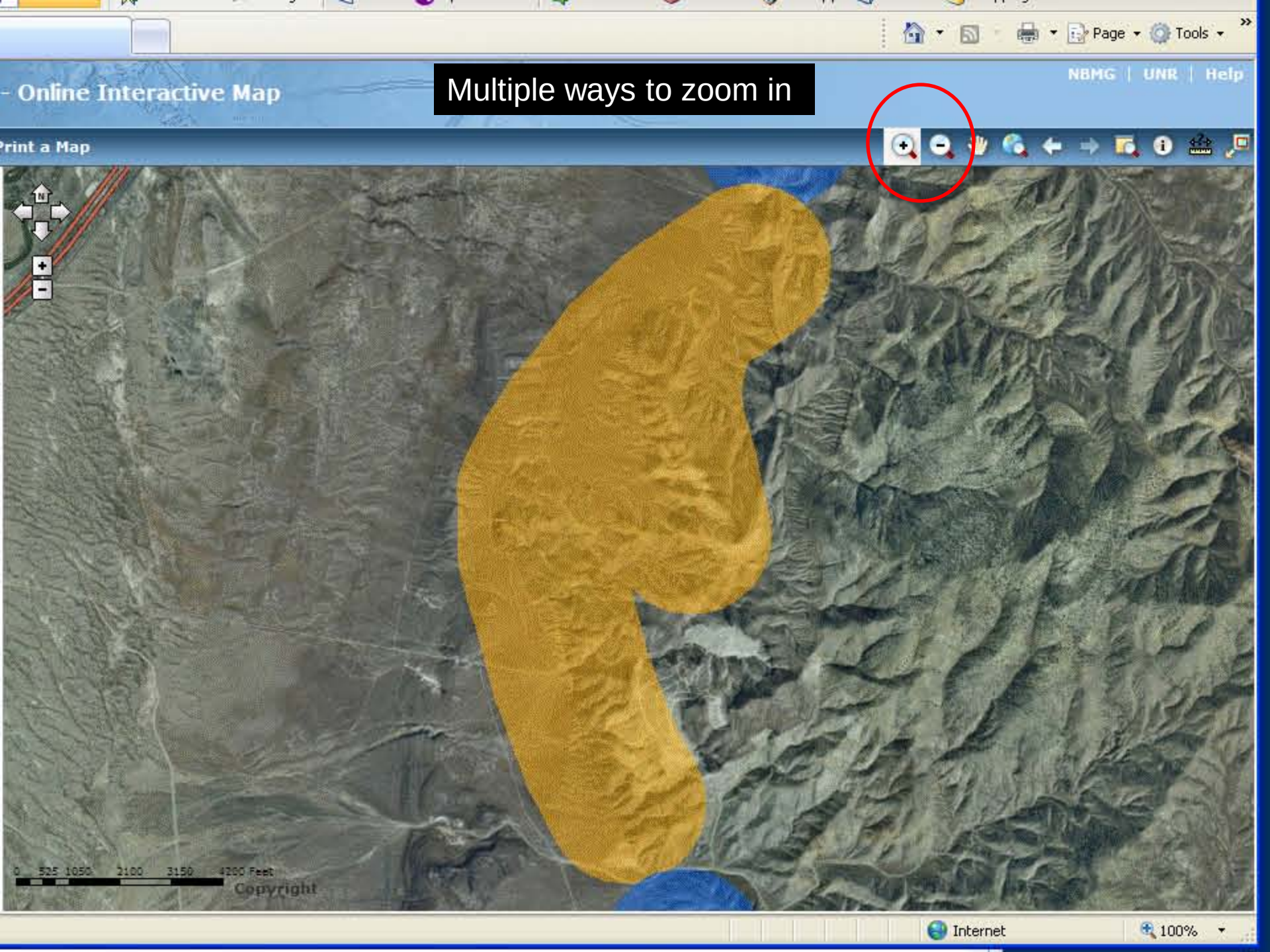
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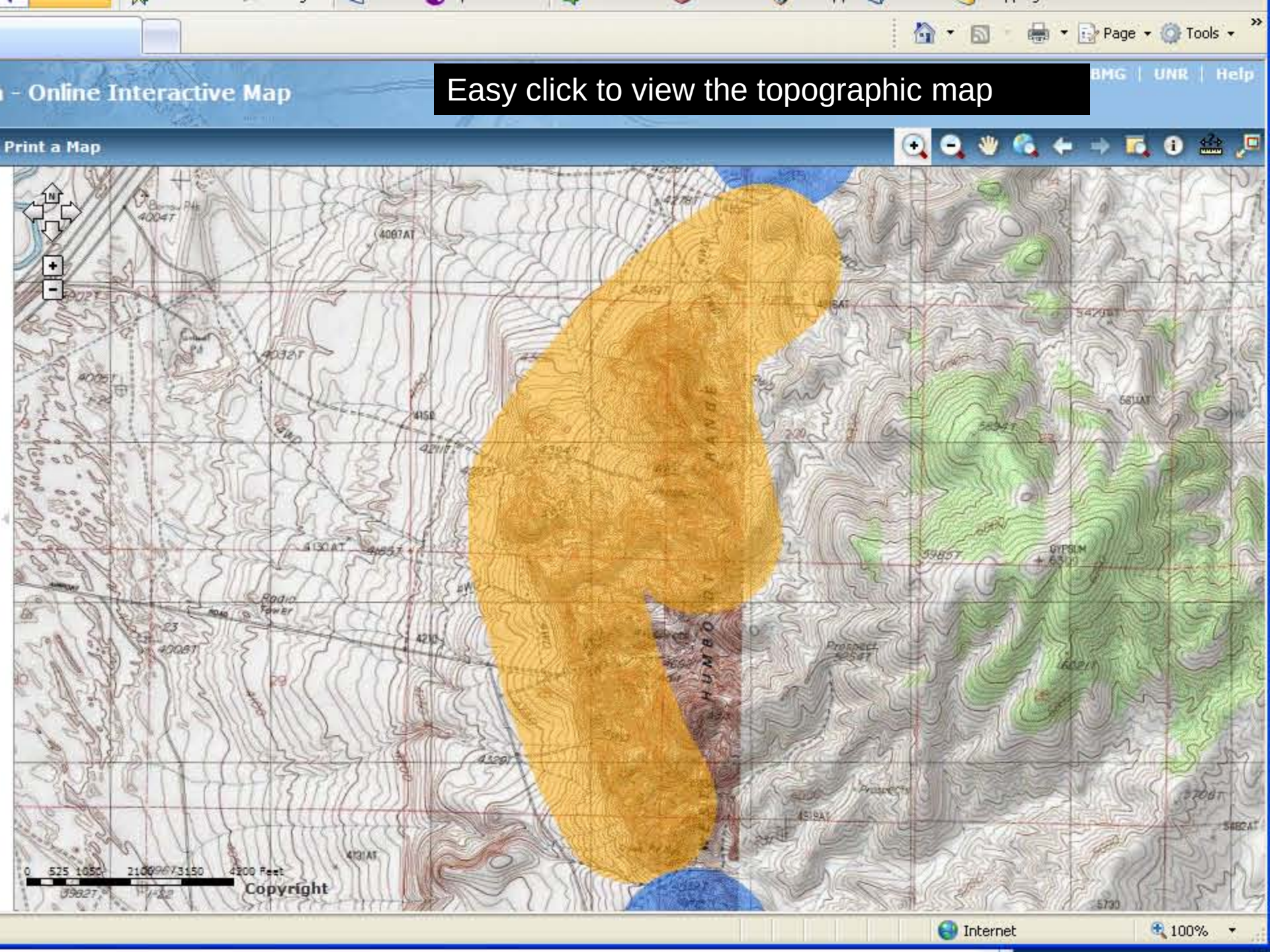
Page
Tools
- Online Interactive Map
Easy click to view the topographic map
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Print a Map
HUMBOLDT
Radio Tower
Prospect
GYPSUM
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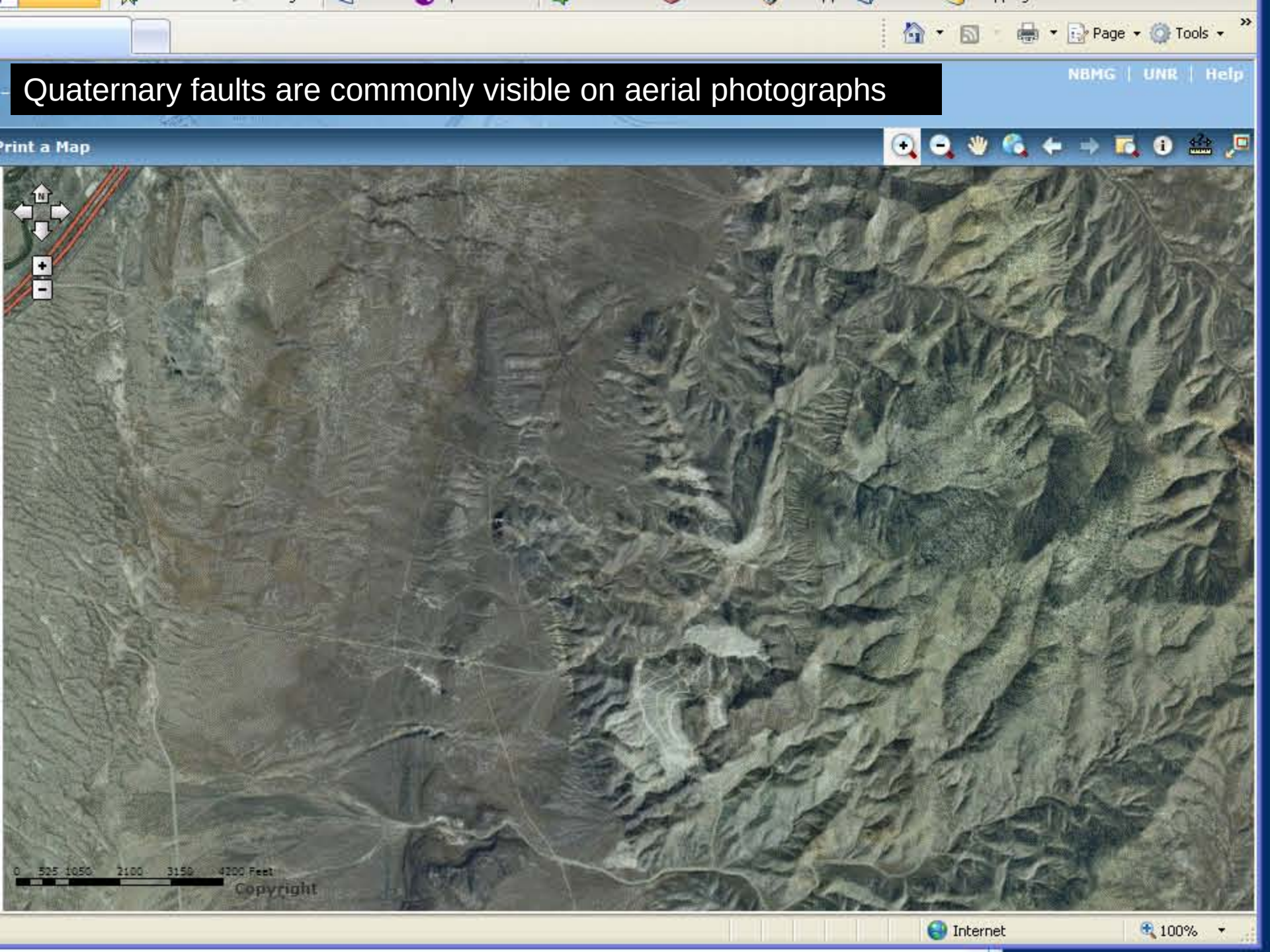
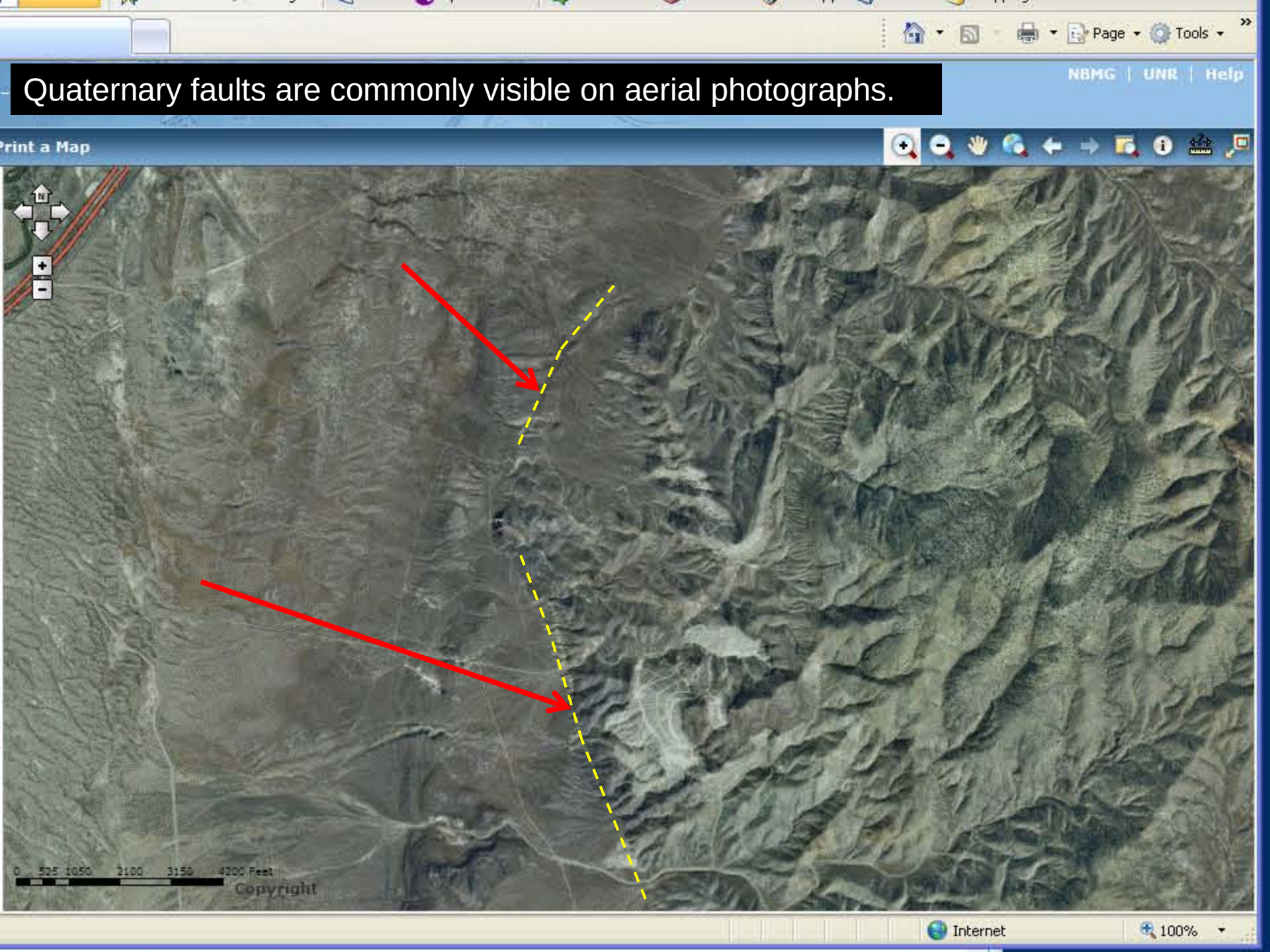
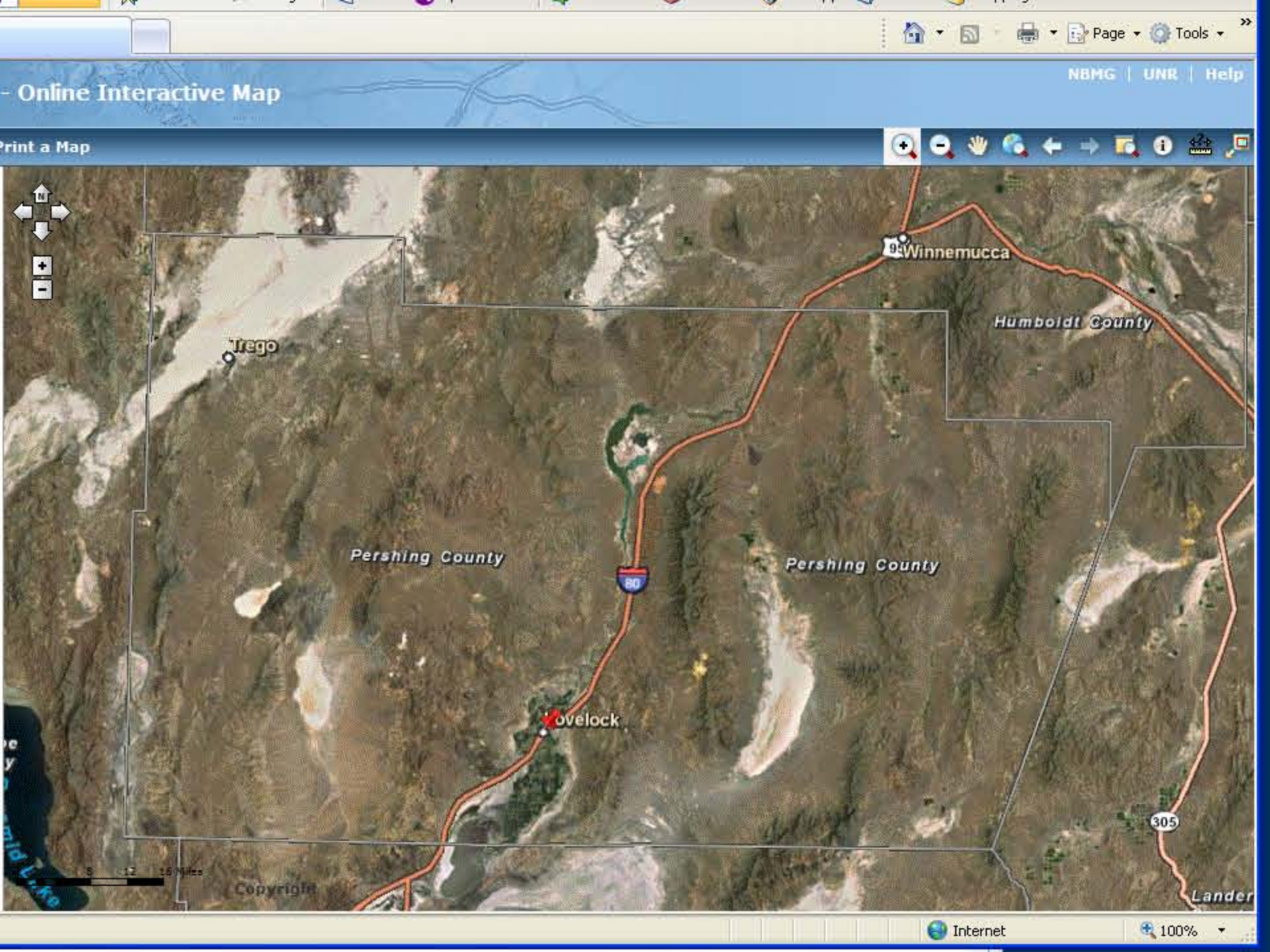
Quaternary faults are commonly visible on aerial photographs



Quaternary faults are commonly visible on aerial photographs.




Page
Tools
NBMG | UNR | Help
- Online Interactive Map
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Winnemucca
Humboldt County
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Pershing County
Pershing County
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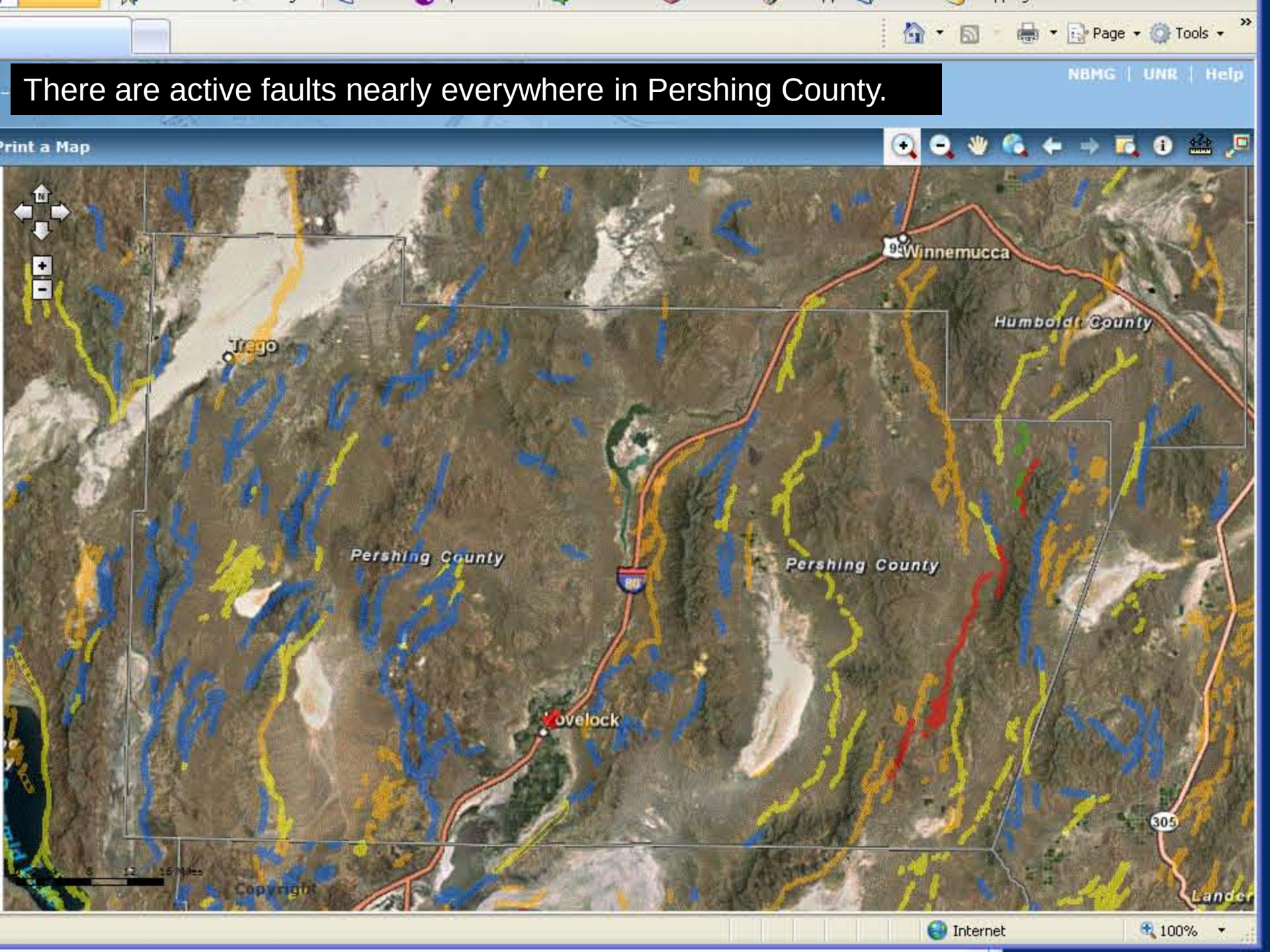
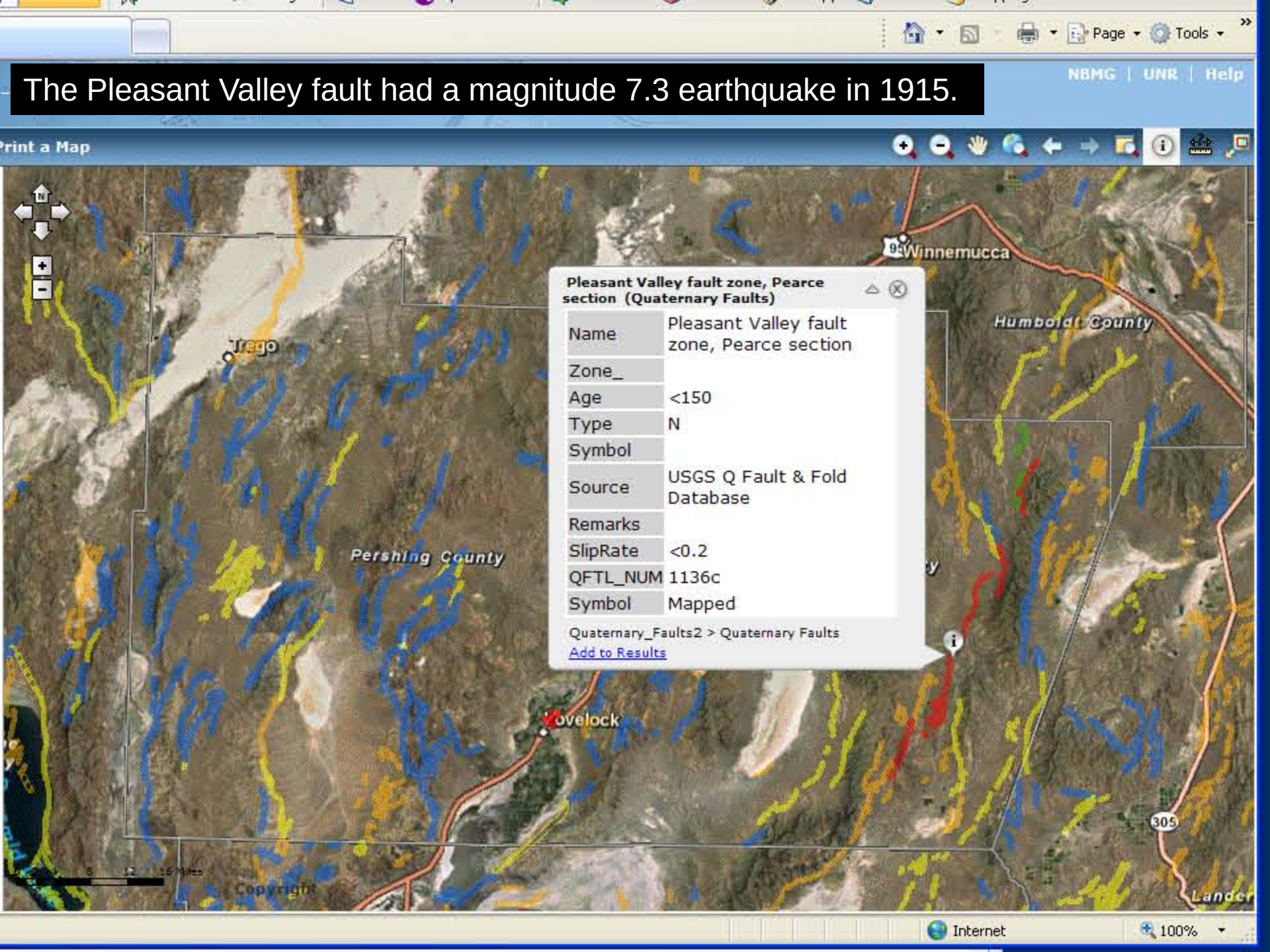
There are active faults nearly everywhere in Pershing County.



The Pleasant Valley fault had a magnitude 7.3 earthquake in 1915.



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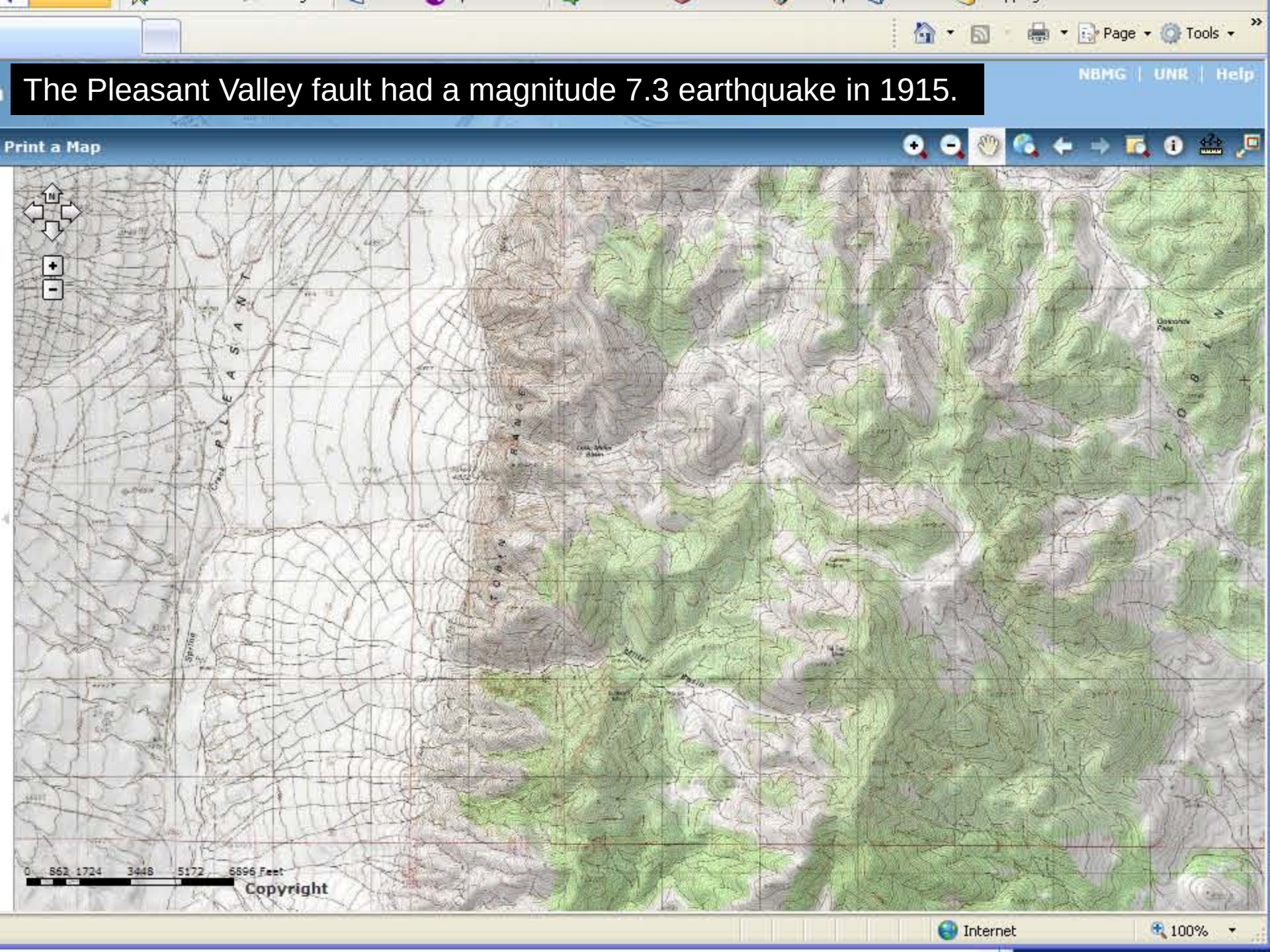

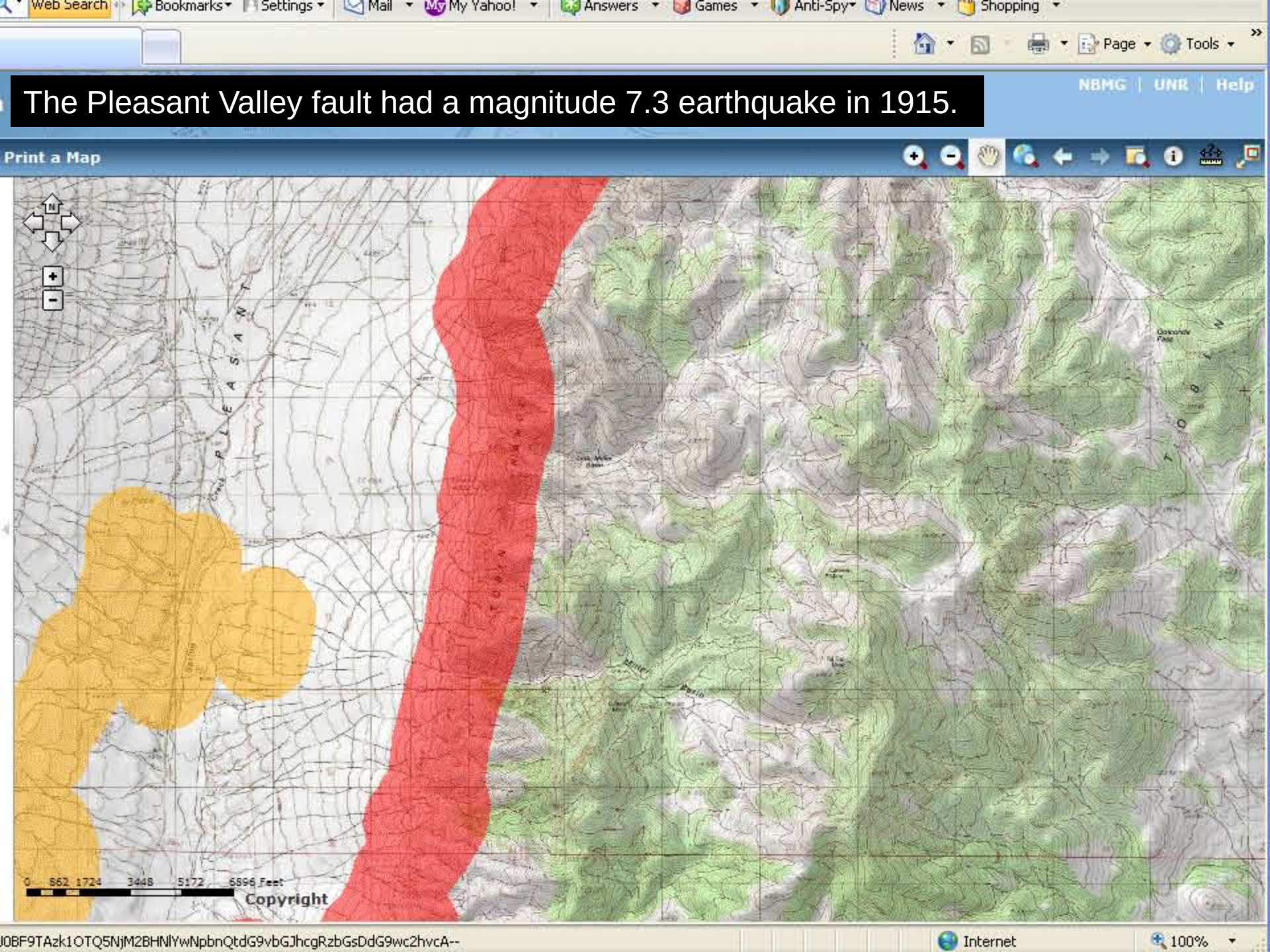
The Pleasant Valley fault had a magnitude 7.3 earthquake in 1915.
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Bookmarks
Settings
Mail
My Yahoo!
Answers
Games
Anti-Spy
News
Shopping
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Tools
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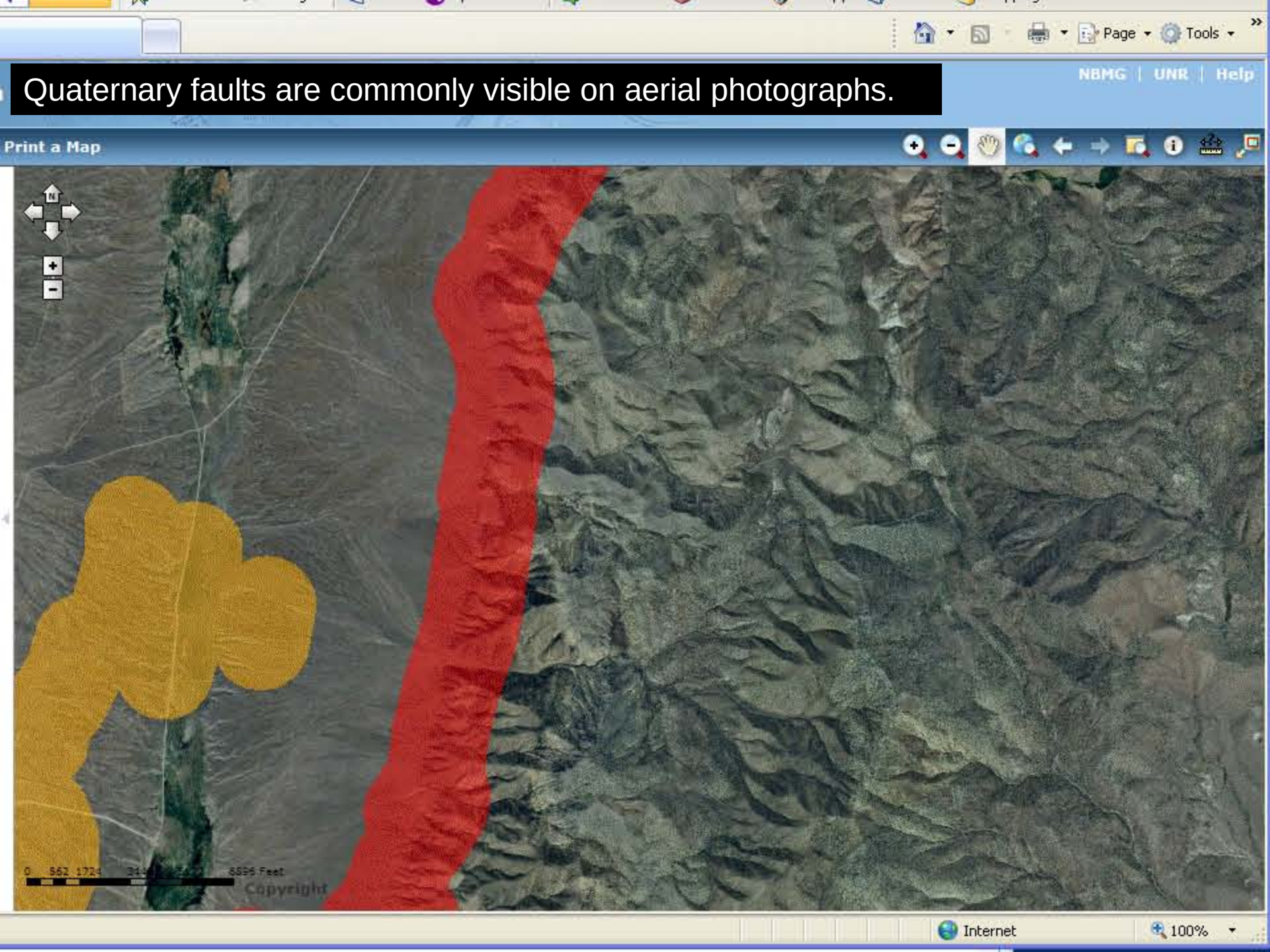
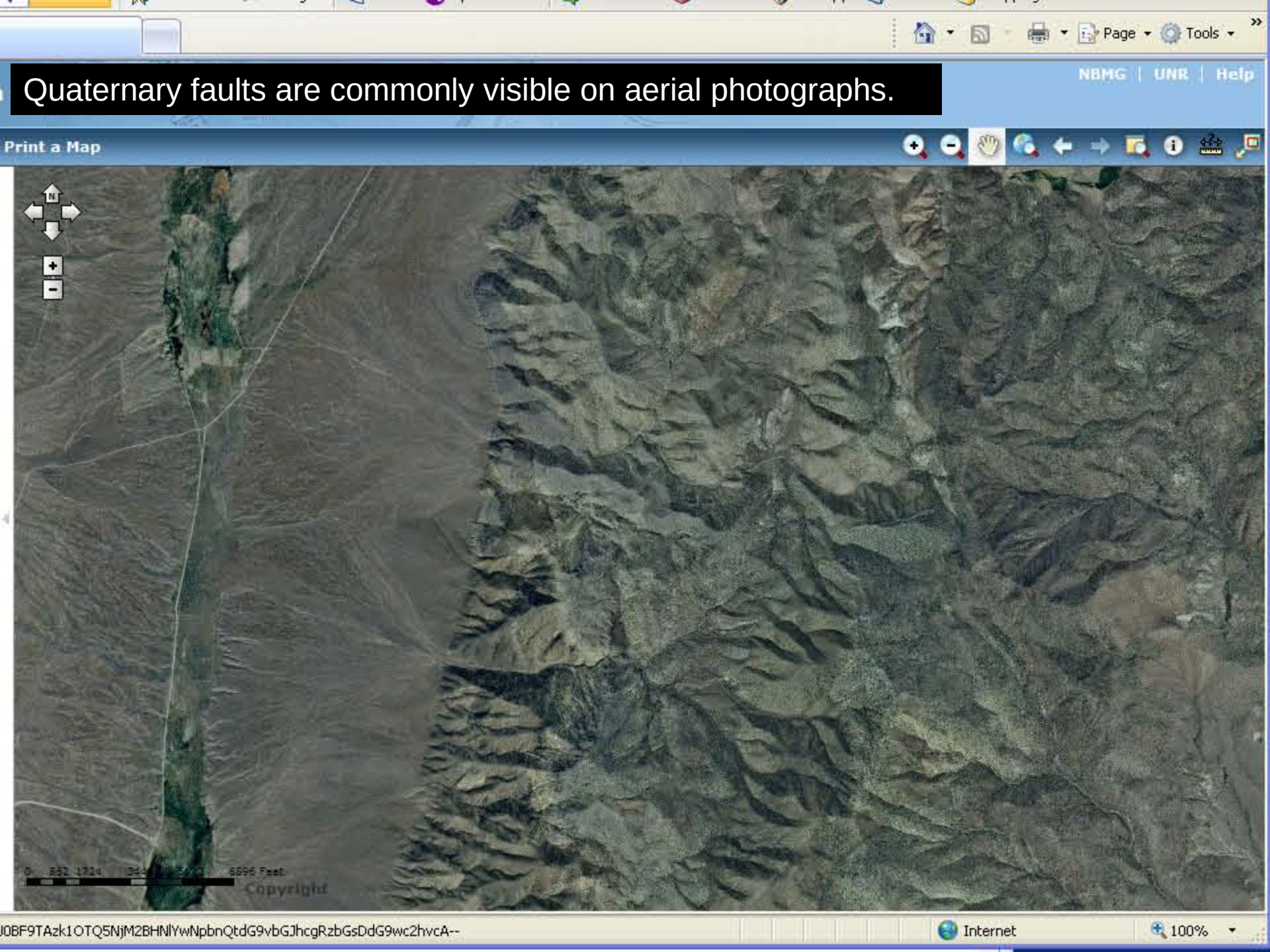
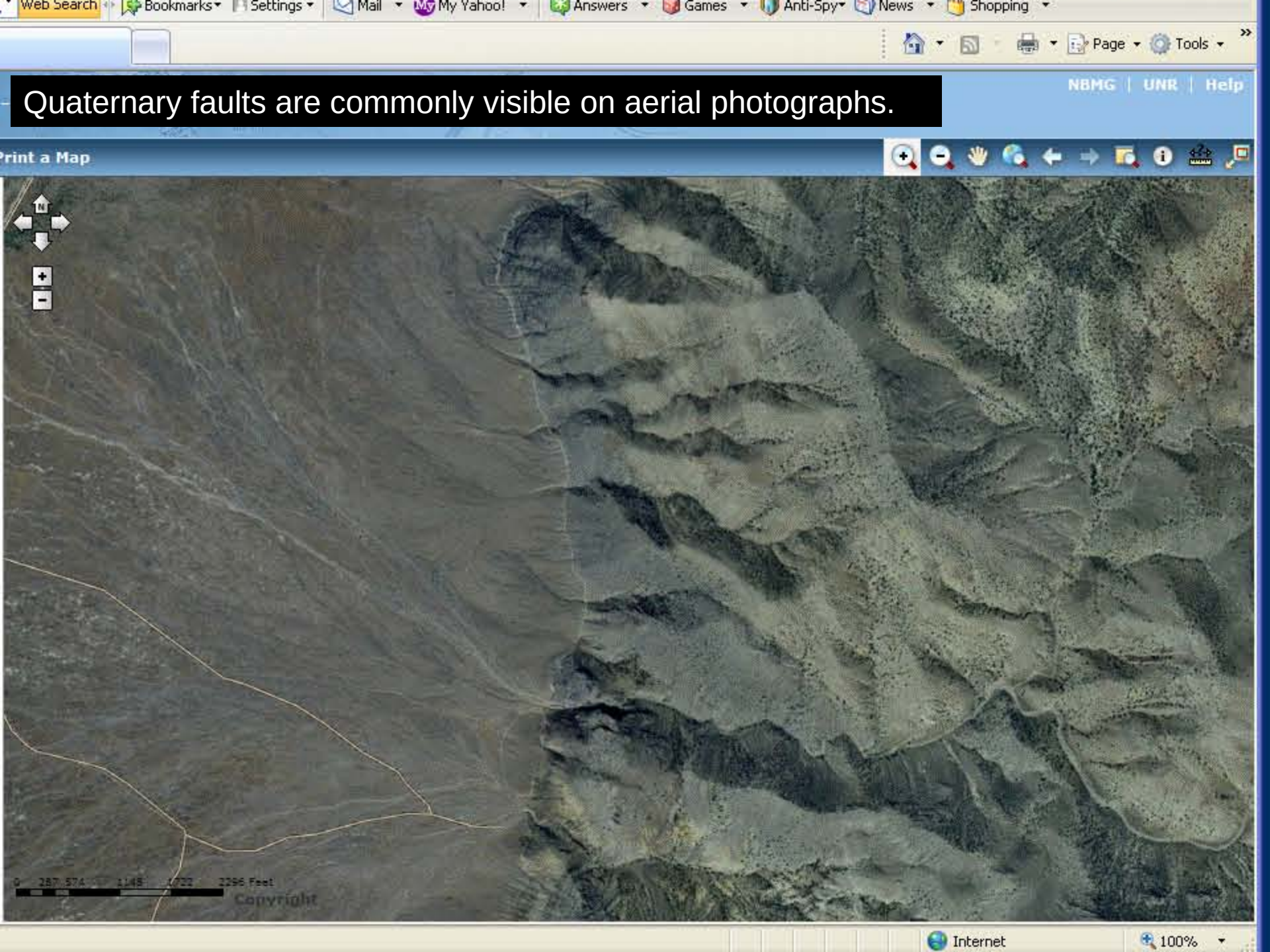
Quaternary faults are commonly visible on aerial photographs.



Quaternary faults are commonly visible on aerial photographs.




Quaternary faults are commonly visible on aerial photographs.
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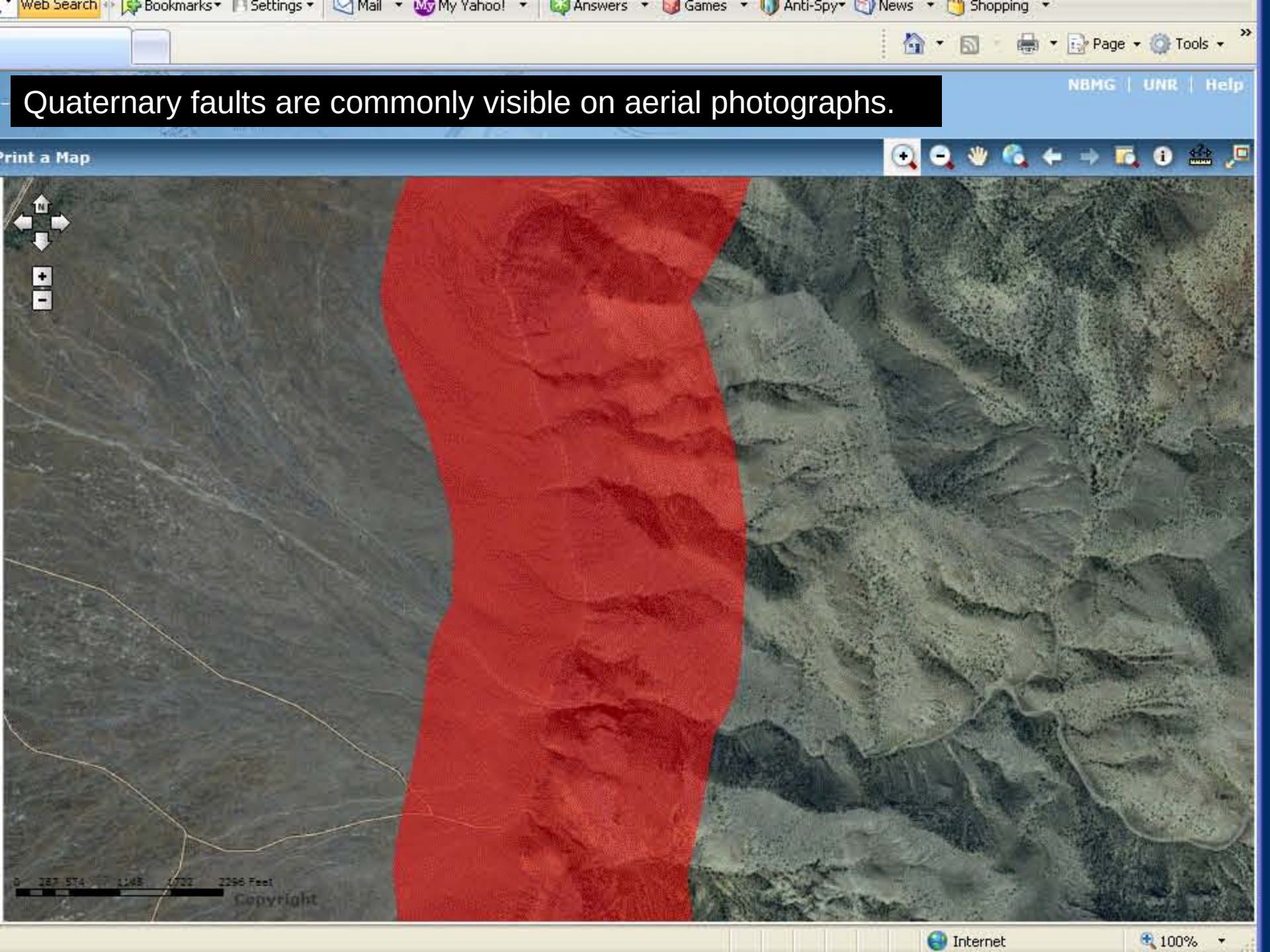
Quaternary faults are commonly visible on aerial photographs.
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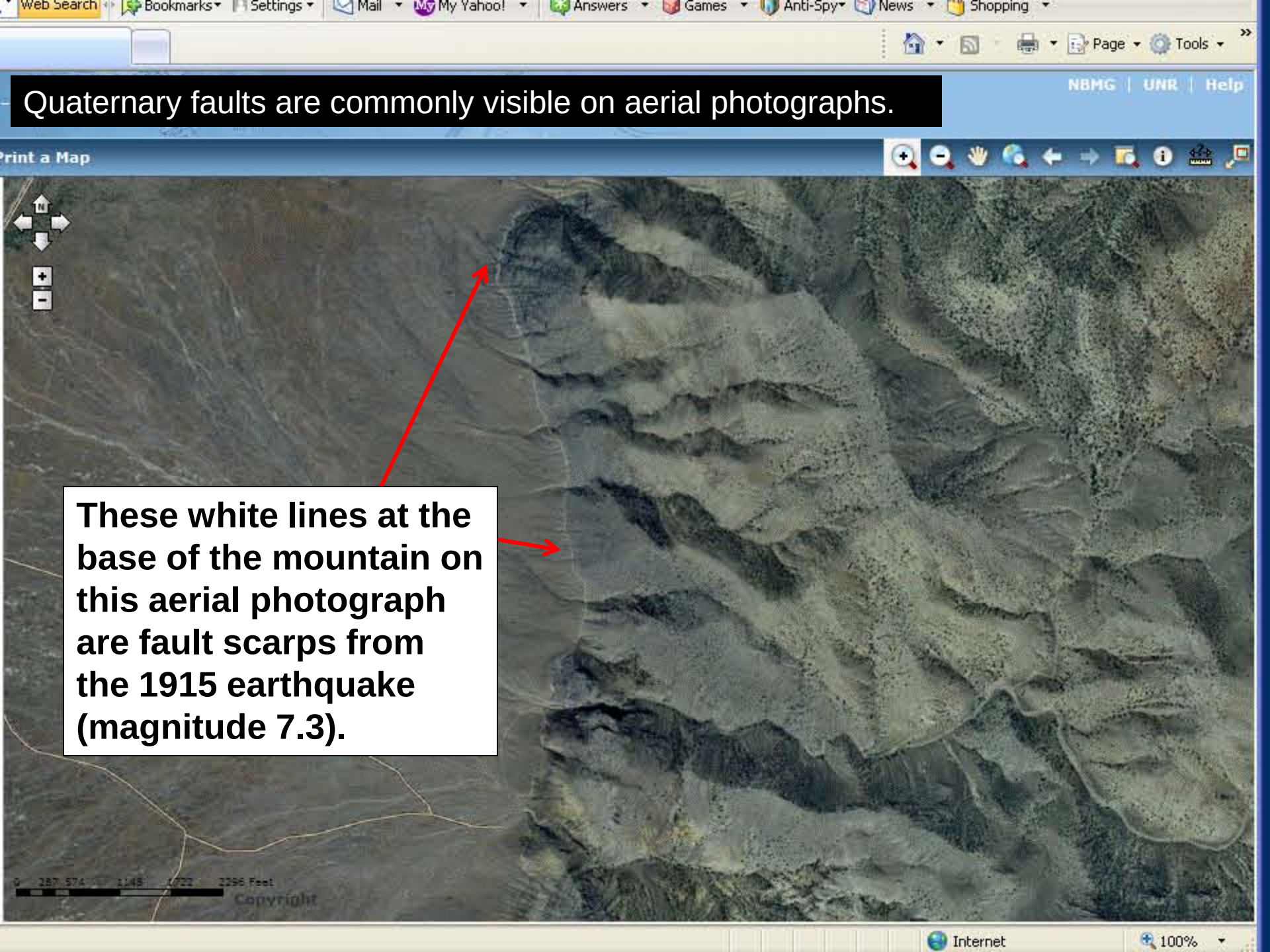
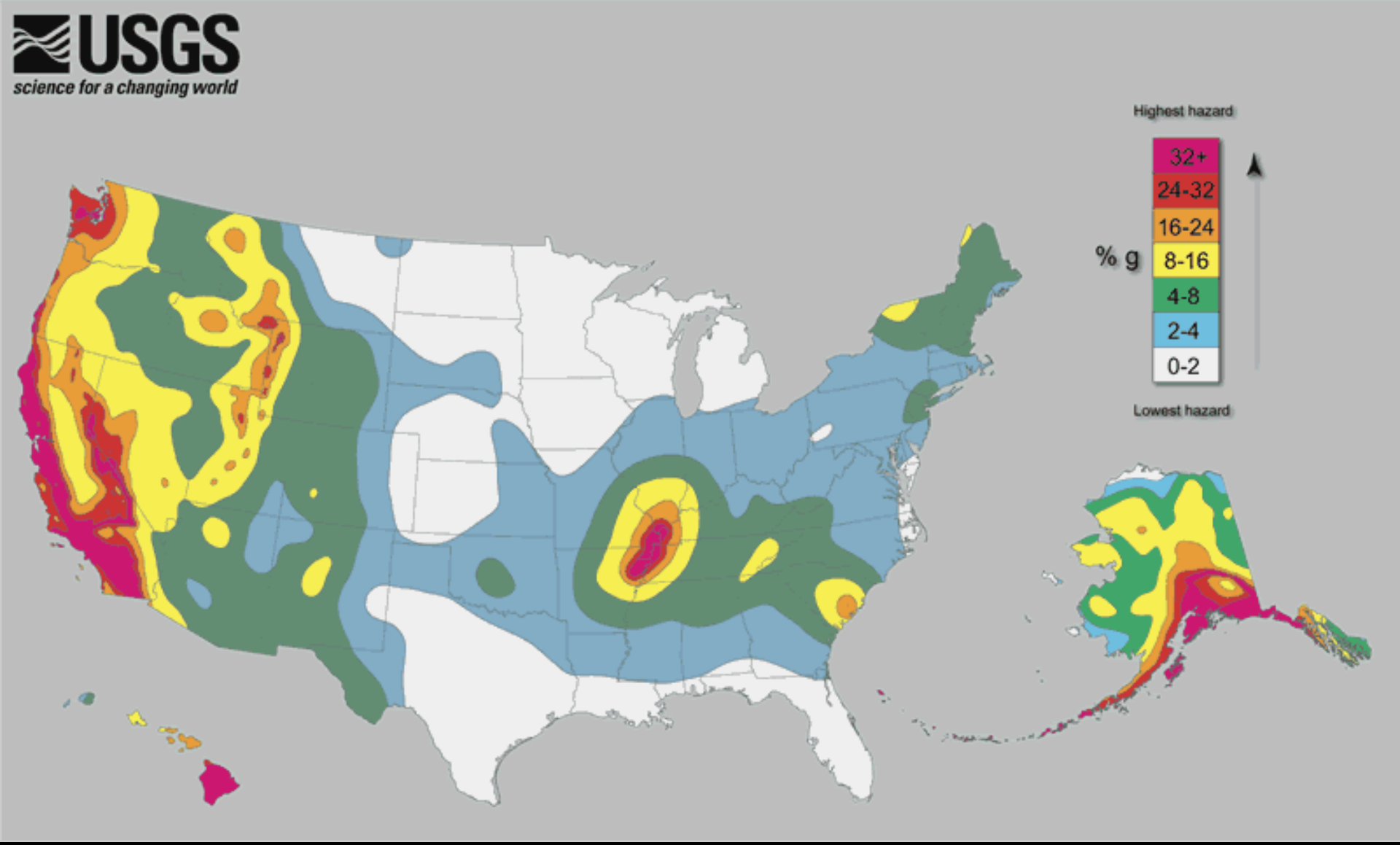
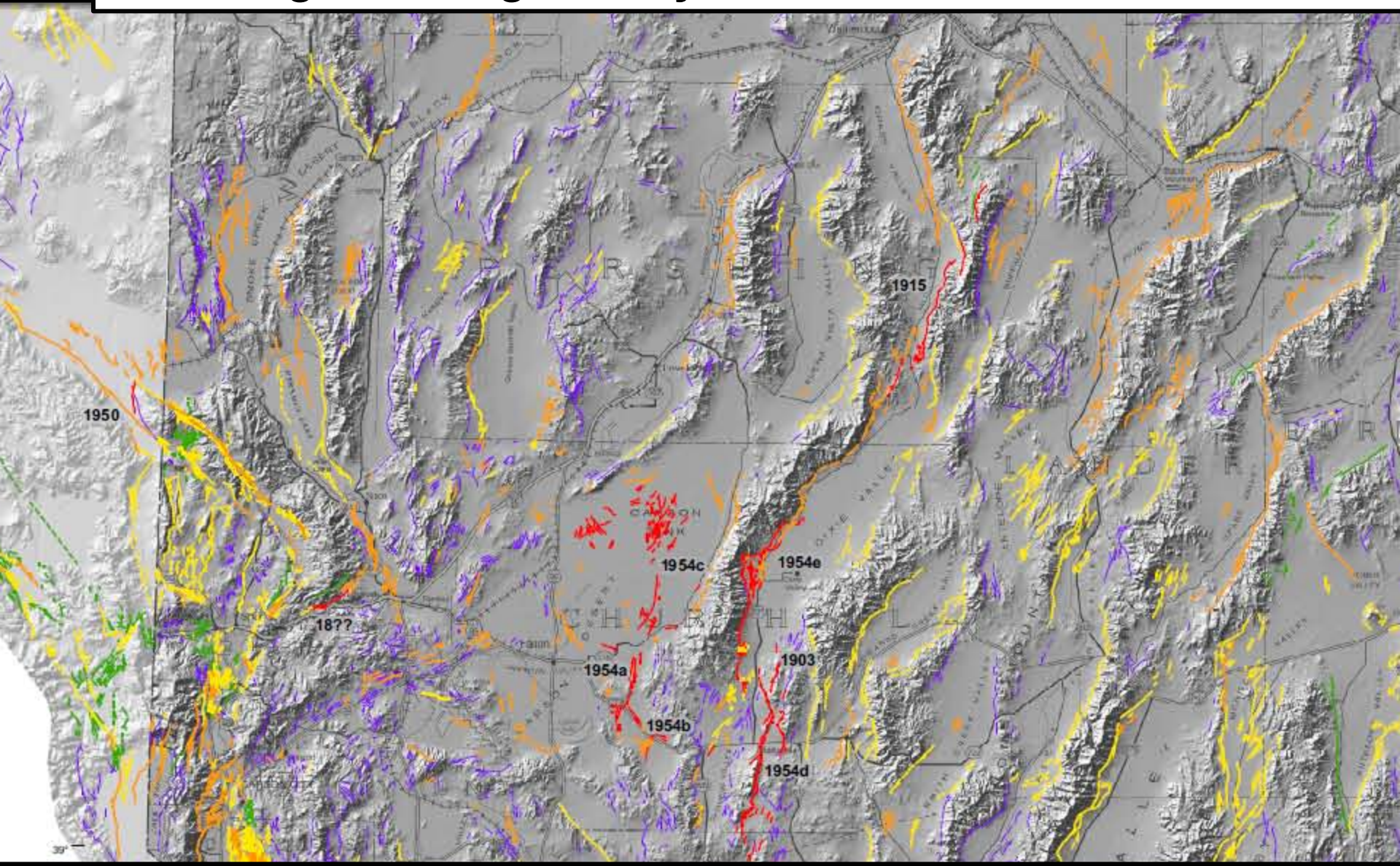
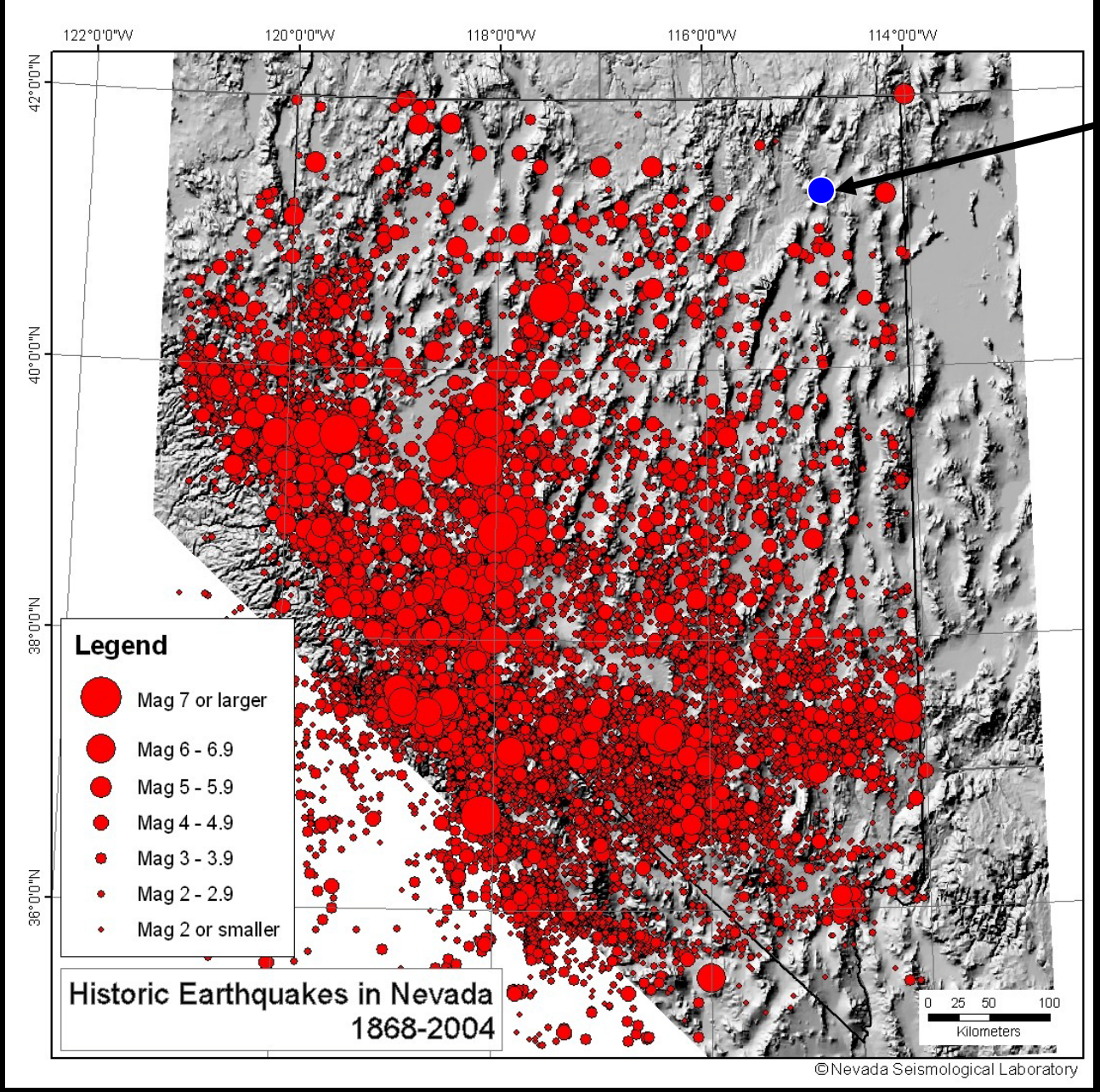

Quaternary faults are commonly visible on aerial photographs.
These white lines at the base of the mountain on this aerial photograph are fault scarps from the 1915 earthquake (magnitude 7.3).



The USGS integrates (1) fault, (2) earthquake, and (3) geodetic data into its probabilistic seismic hazard analysis.

(1) Active faults occur nearly everywhere in Nevada, including Pershing County.





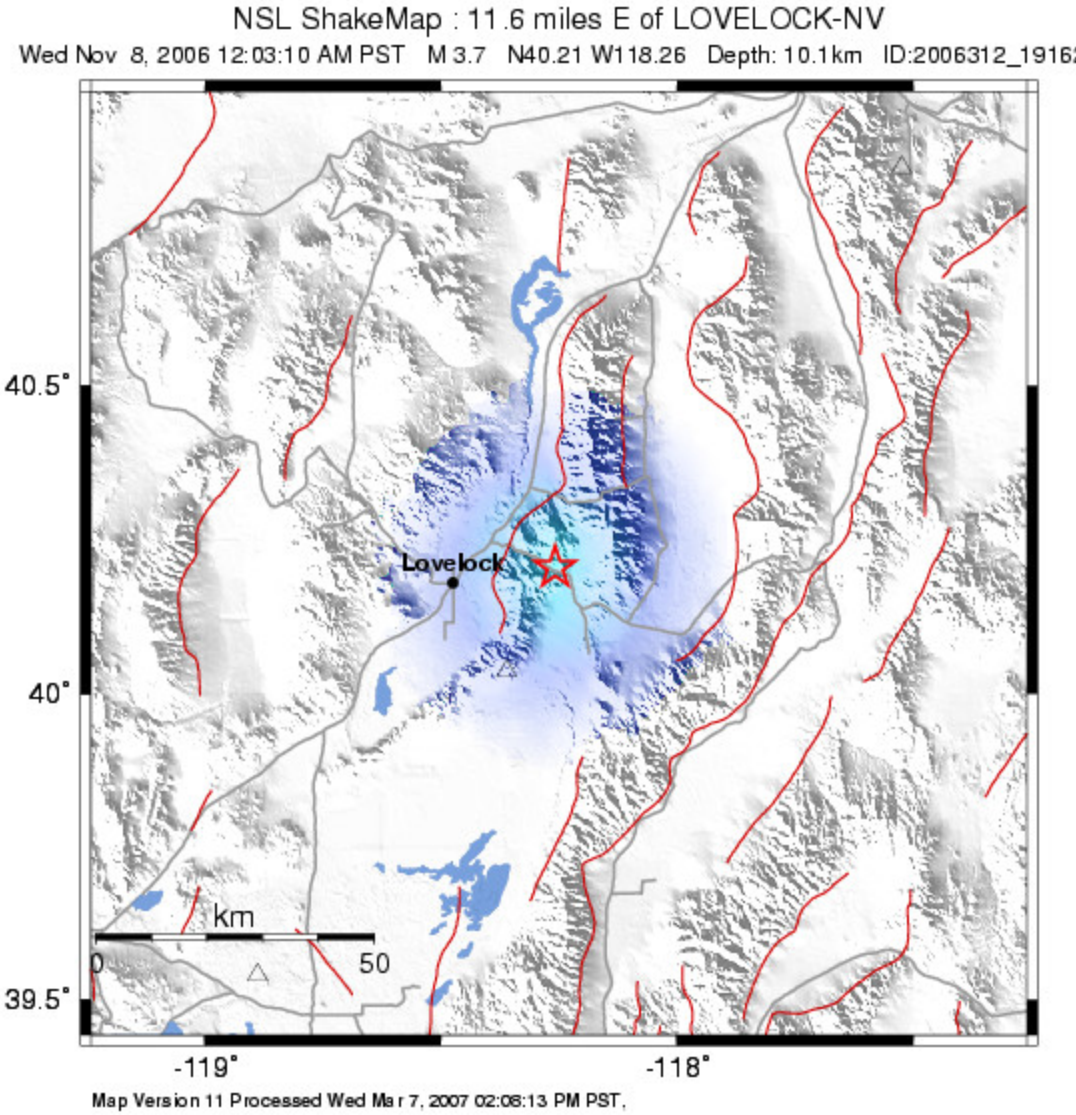
(2) Earthquakes have occurred throughout Nevada.

Large Historical Earthquakes in Pershing and Churchill Counties

Date	Magnitude	Near
1852?	7.3	Fallon
1915	7.3	Pleasant Valley
July 6, 1954 (a)	6.6	Rainbow Mtn.
11 hours later (b)	6.0	Fourmile Flat
August 24, 1954 (c)	6.8	Stillwater
December 16, 1954 (d)	7.1	Fairview Peak
4 minutes later (e)	6.8	Dixie Valley
March 23, 1959	6.3	Dixie Valley

ShakeMap from the Nevada Seismological Laboratory at UNR

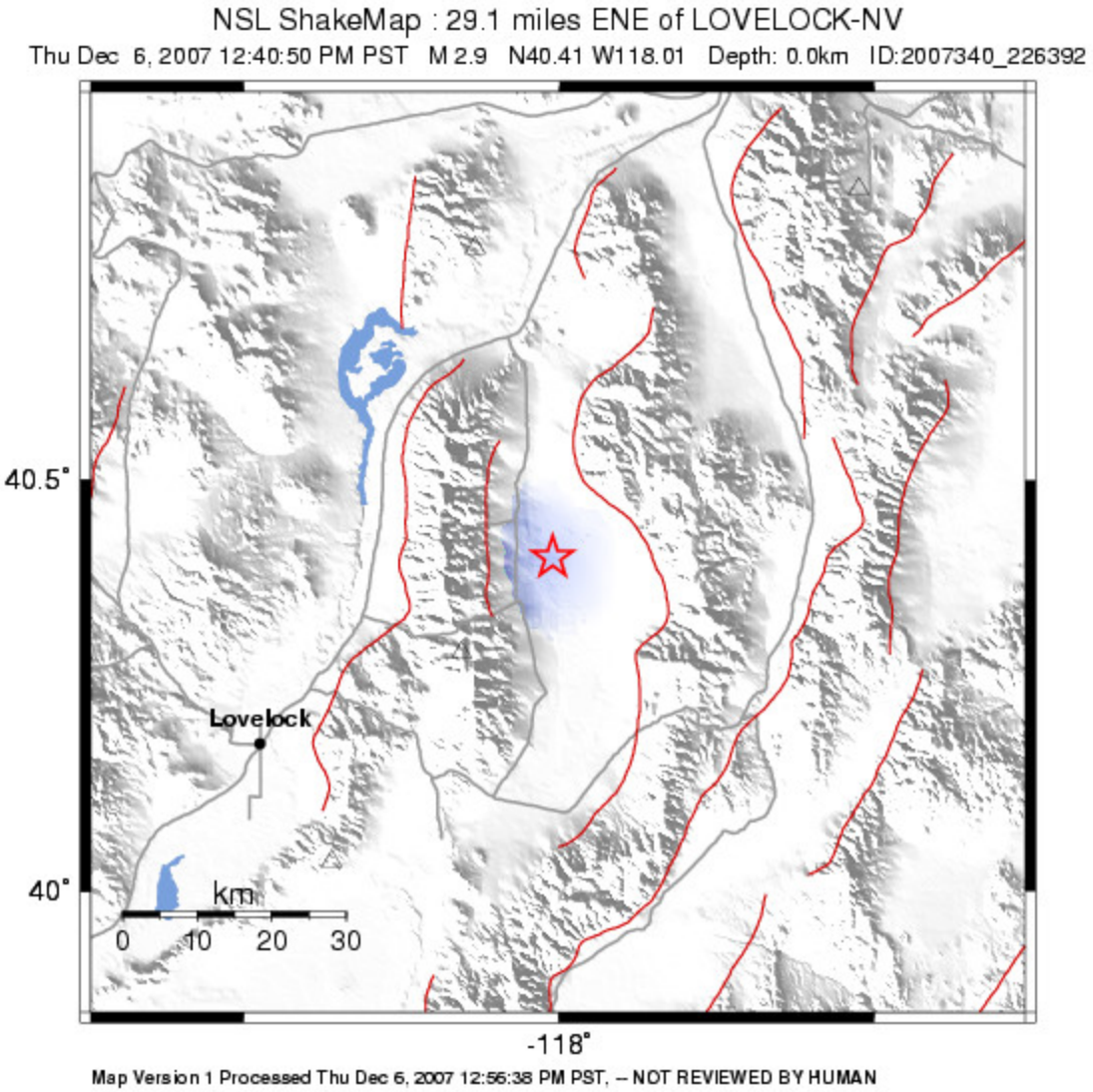
Magnitude 3.7
12 miles E of Lovelock
on Nov. 8, 2006



PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	*<.17*	*.17-1.4*	*1.4-3.9*	*3.9-9.2*	*9.2-18*	18-34	34-65	65-124	>124
PEAK VEL.(cm/s)	<0.1	0.1-1.1	1.1-3.4	3.4-8.1	8.1-16	*16-31*	*31-60*	*60-116*	*>116*
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

ShakeMap from the Nevada Seismological Laboratory at UNR

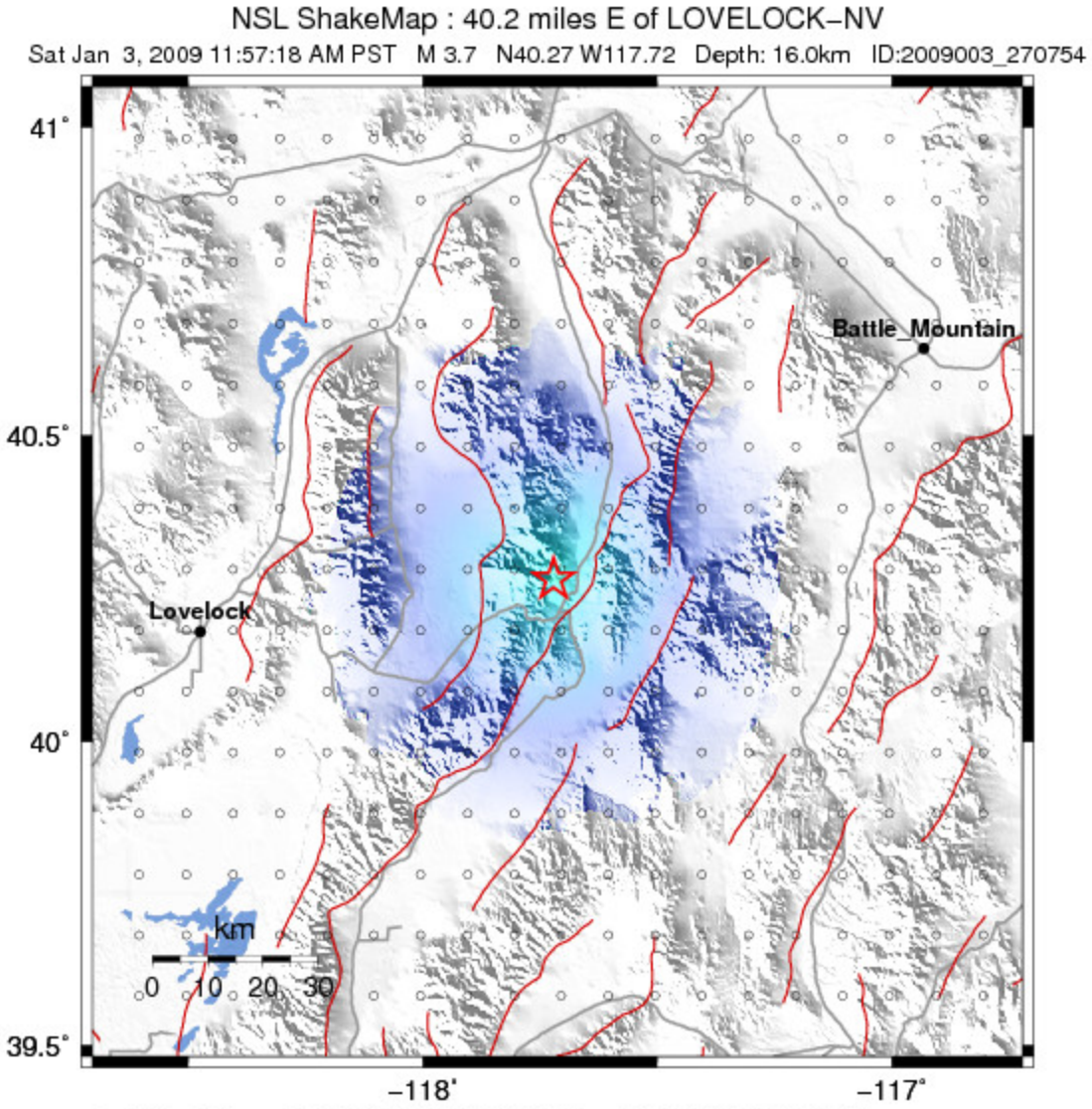
Magnitude 2.9
29 miles ENE of Lovelock
on Dec. 6, 2007



PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	*<.17*	*.17-1.4*	*1.4-3.9*	*3.9-9.2*	*9.2-18*	18-34	34-65	65-124	>124
PEAK VEL.(cm/s)	<0.1	0.1-1.1	1.1-3.4	3.4-8.1	8.1-16	*16-31*	*31-60*	*60-116*	*>116*
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

ShakeMap from the Nevada Seismological Laboratory at UNR

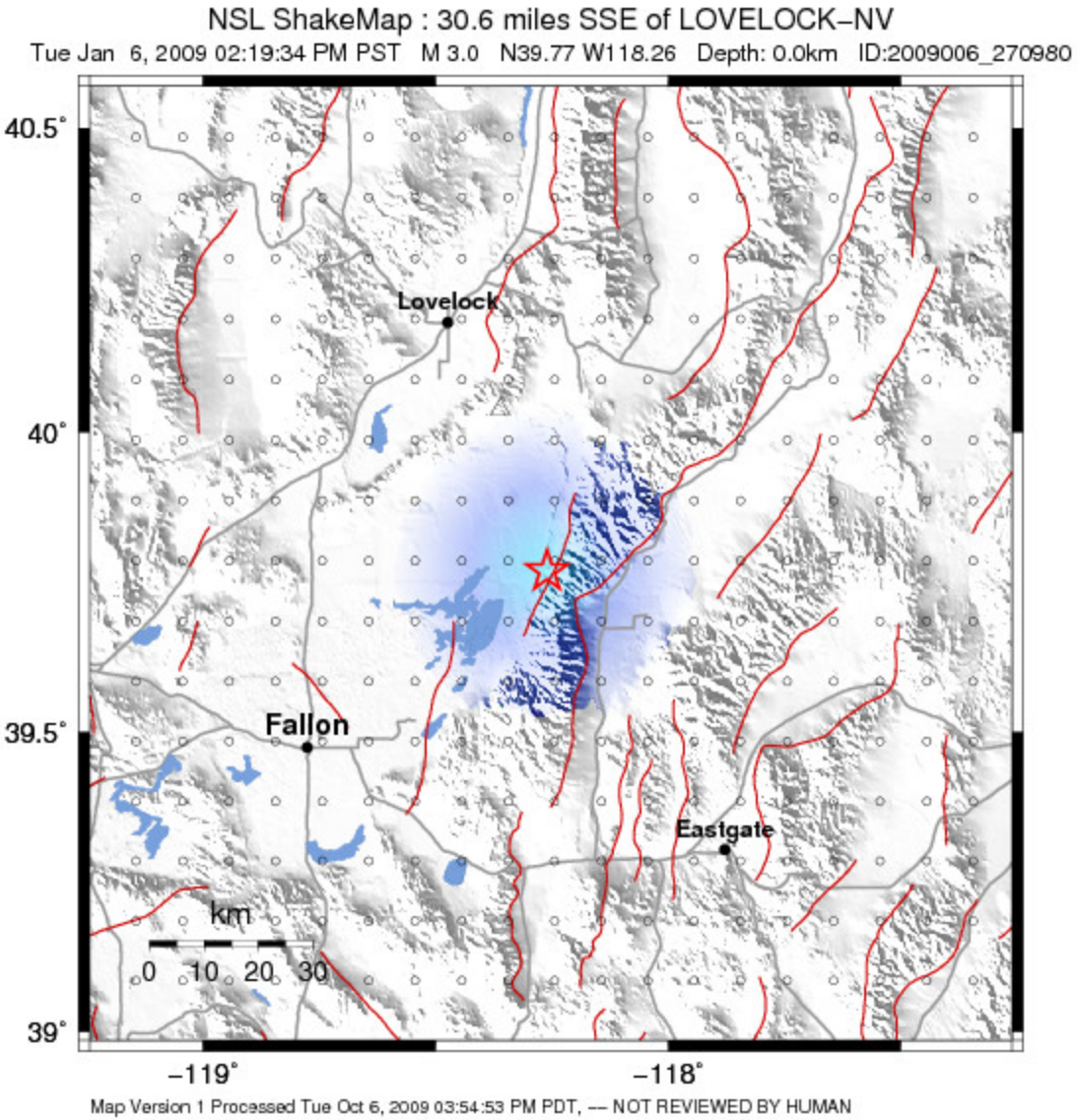
Magnitude 3.7
40 miles E of Lovelock
on January 3, 2009



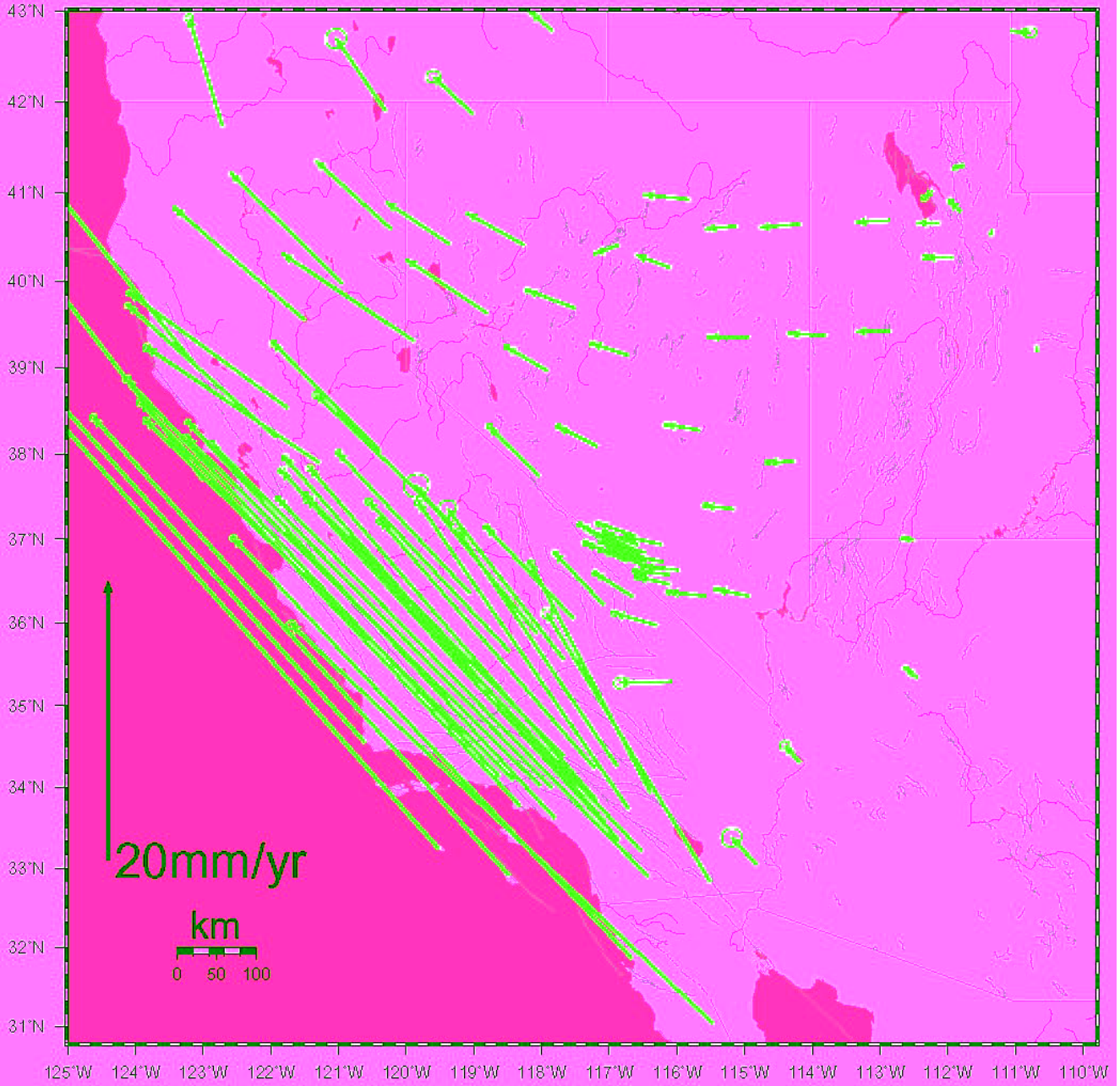
PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	*<.17*	*.17–1.4*	*1.4–3.9*	*3.9–9.2*	*9.2–18*	18–34	34–65	65–124	>124
PEAK VEL.(cm/s)	<0.1	0.1–1.1	1.1–3.4	3.4–8.1	*8.1–16*	*16–31*	*31–60*	*60–116*	*>116*
INSTRUMENTAL INTENSITY	I	II–III	IV	V	VI	VII	VIII	IX	X+

ShakeMap from the Nevada Seismological Laboratory at UNR

Magnitude 3.0
31 miles SSE of Lovelock
on January 6, 2009

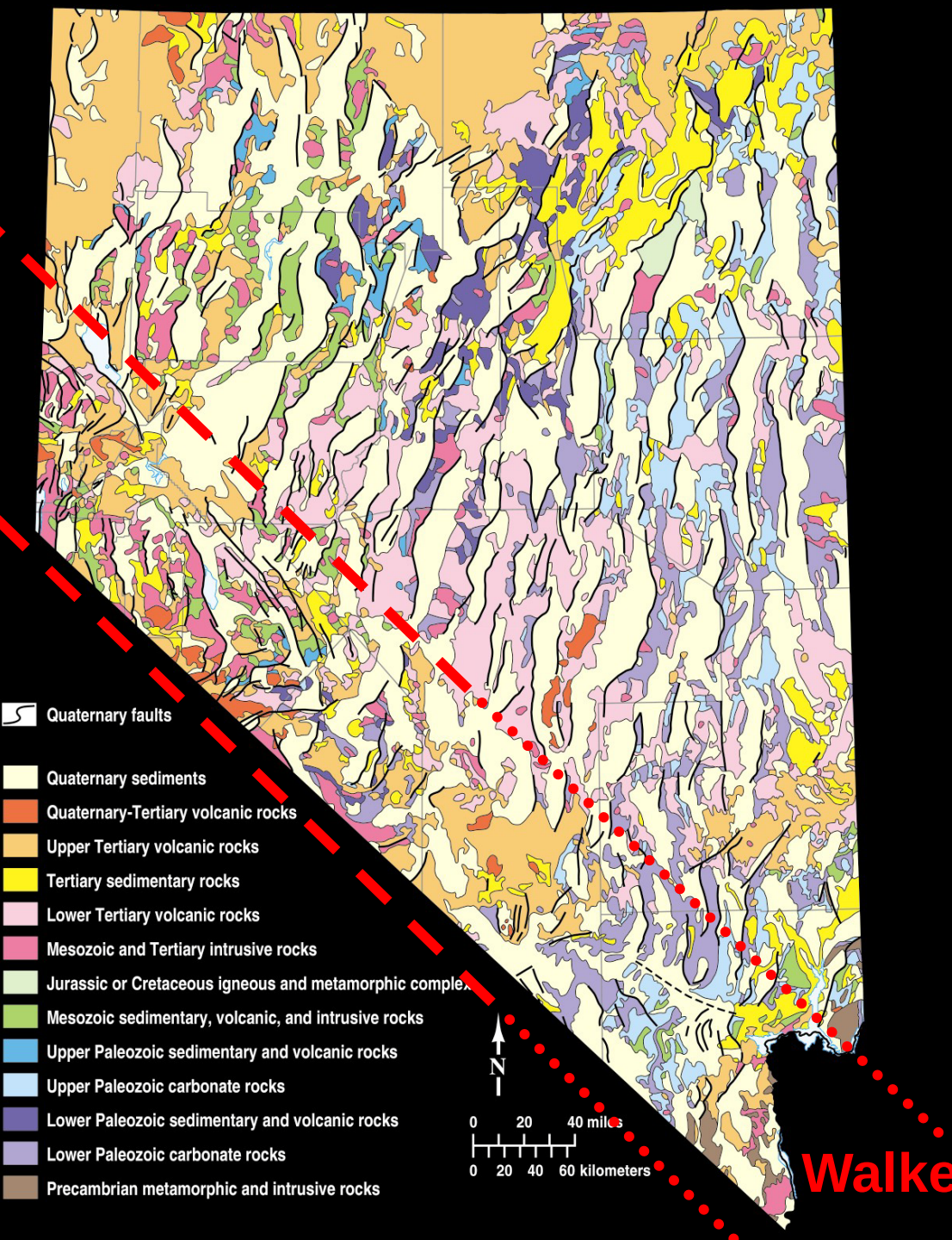


PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	*<.17*	*.17–1.4*	*1.4–3.9*	*3.9–9.2*	*9.2–18*	18–34	34–65	65–124	>124
PEAK VEL.(cm/s)	<0.1	0.1–1.1	1.1–3.4	3.4–8.1	*8.1–16*	*16–31*	*31–60*	*60–116*	*>116*
INSTRUMENTAL INTENSITY	I	II–III	IV	V	VI	VII	VIII	IX	X+



(3) Geodetic data indicate that the Basin and Range province is gaining about 1.3 acres of area per year through crustal extension, and that western Nevada is accommodating ~20% of the North American-Pacific plate interaction.

Kreemer and Hammond (2007)

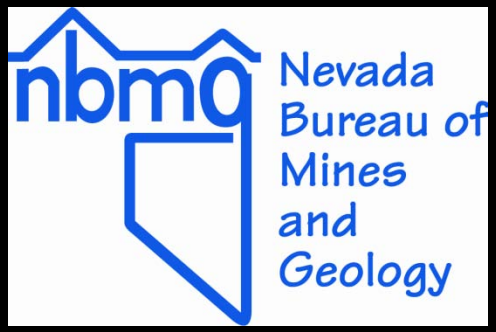


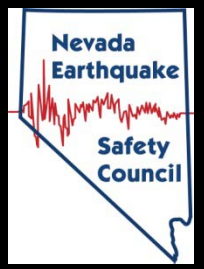
In Nevada, much of the right-lateral shear between the North American and Pacific plates occurs along northwest-striking strike-slip faults of the Walker Lane.

Extension largely is accommodated along N- to NE-striking, basin-bounding normal faults.

Earthquake faults occur throughout Nevada, and potential losses from earthquakes are high for many communities.

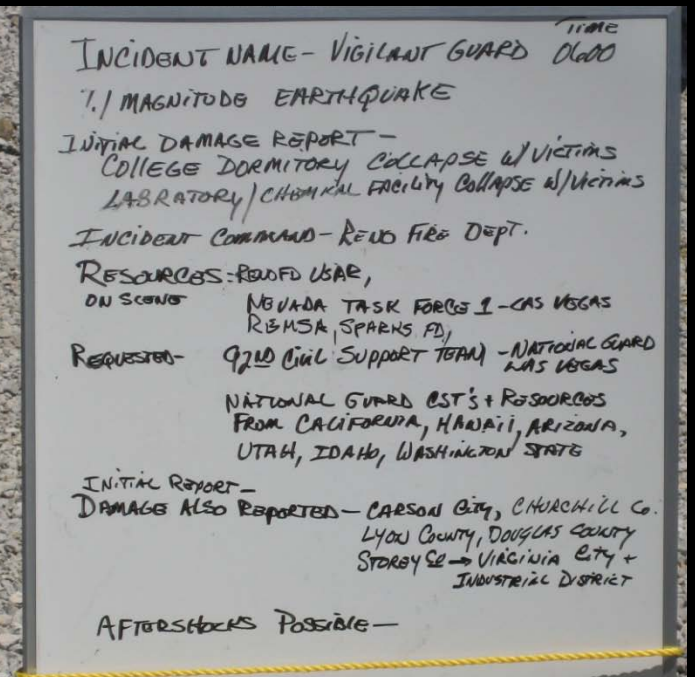
NBMG Open-File Report 09-8, *Estimated Losses from Earthquakes near Nevada Communities*, demonstrates that the consequences of earthquakes can be huge in Nevada, particularly if individuals are not prepared.





Earthquake risks in Nevada are assessed by the Nevada Bureau of Mines and Geology using the Federal Emergency Management Agency's loss-estimation model, HAZUS-MH, and the U.S. Geological Survey's probabilistic seismic hazard analysis.

These loss estimates are useful in hazard-mitigation planning, in building scenarios for emergency response and recovery exercises, and in helping emergency managers and the Governor make decisions on official disaster declarations after an actual earthquake.



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NBMG Open-File Report 09-8, *Estimated Losses from Earthquakes near Nevada Communities*, contains HAZUS scenarios for magnitude 5.0, 5.5, 6.0, 6.5, and 7.0 earthquakes near 38 communities in Nevada.

The hazard: expressed in terms of probability of an earthquake of a given magnitude occurring within 50 years and within 50 km of the community.

	% Probability of magnitude greater than or equal to magnitude				
Community	5.0	5.5	6.0	6.5	7.0
Dayton	>90	~80	70-75	50-55	12-15
Carson City	>90	~80	70	50-55	12-15
Reno	>90	~80	67	50	12-15
Stateline	>90	~80	60-70	40-50	10
Lovelock	50-60	~35	10-20	10	1-2
Las Vegas	40-50	~30	12	4-5	<0.5
Elko	30-40	~25	10-15	6-8	0.5-1
Wells	30-40	~20	9	6	0.5-1
Laughlin	10-20	~5	2-3	0.5-1	<0.5

Data are from the USGS at http://eqint.cr.usgs.gov/eqprob/2002/index.php .
Values for magnitude 5.5 are extrapolated between 5.0 and 6.0.

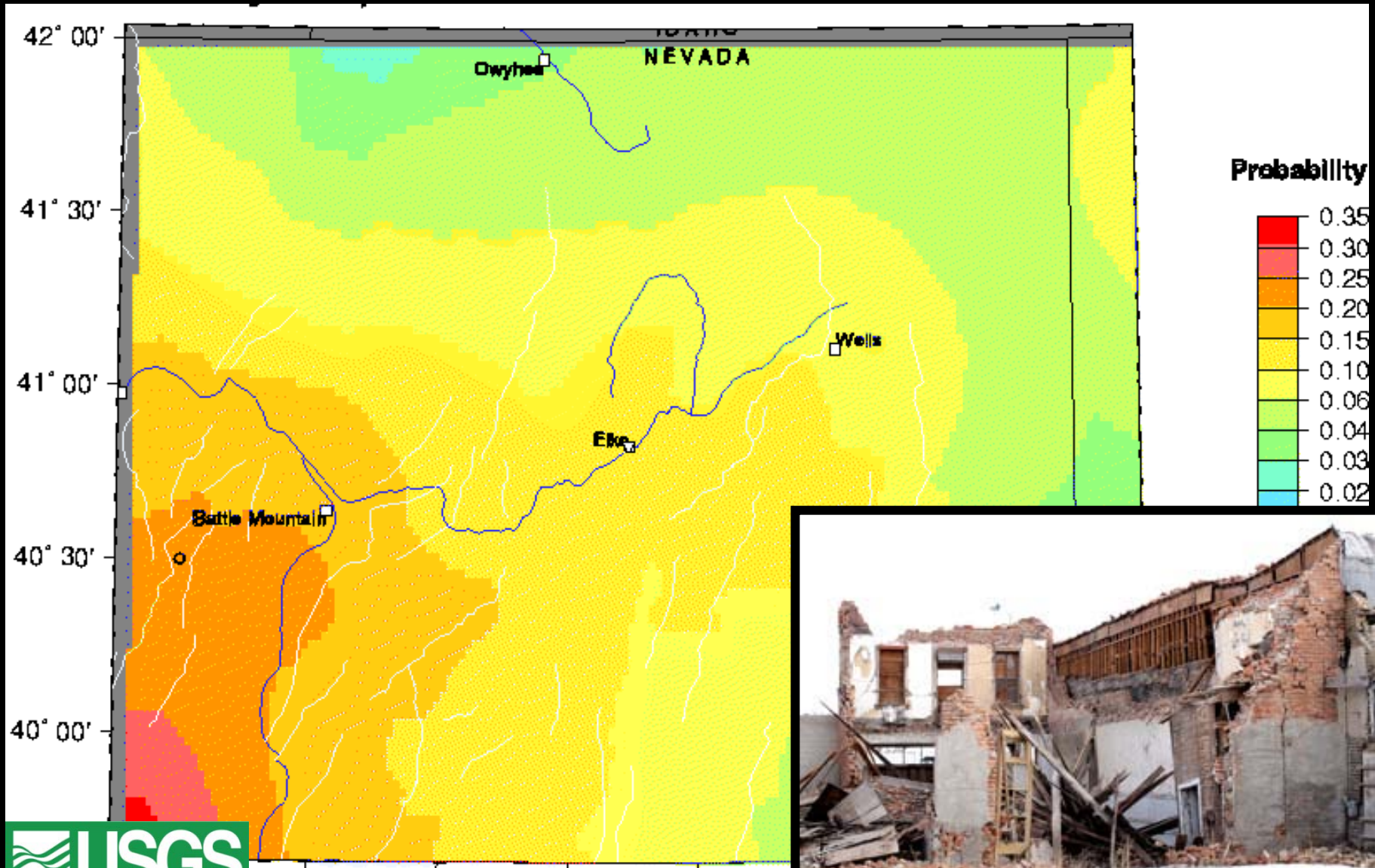
Uncertainties in the location of epicenters, depths, and magnitude, when combined with changing population and uncertainties in local effects (soil and rock types, assumptions about attenuation, basin geometry, liquefaction potential, and directivity), make loss estimates generally consistent within one order of magnitude (a factor of 10).

HAZUS estimates for total economic loss from a magnitude 6.0 earthquake and probability of an earthquake of this magnitude or greater occurring within 50 years and within 50 km of the community.

Community	Total Economic Loss	Probability in 50 years within 50 km
Las Vegas	$7.2 billion	12%
Reno	$1.9 billion	67%
Stateline	$590 million	60 to 70%
Elko	$160 million	10 to 15%
Wells	$30 million	9%
Lovelock	$17 million	10 to 20%

Total economic loss is from HAZUS. Probabilities are from the USGS at http://eqint.cr.usgs.gov/eqprob/2002/index.php .

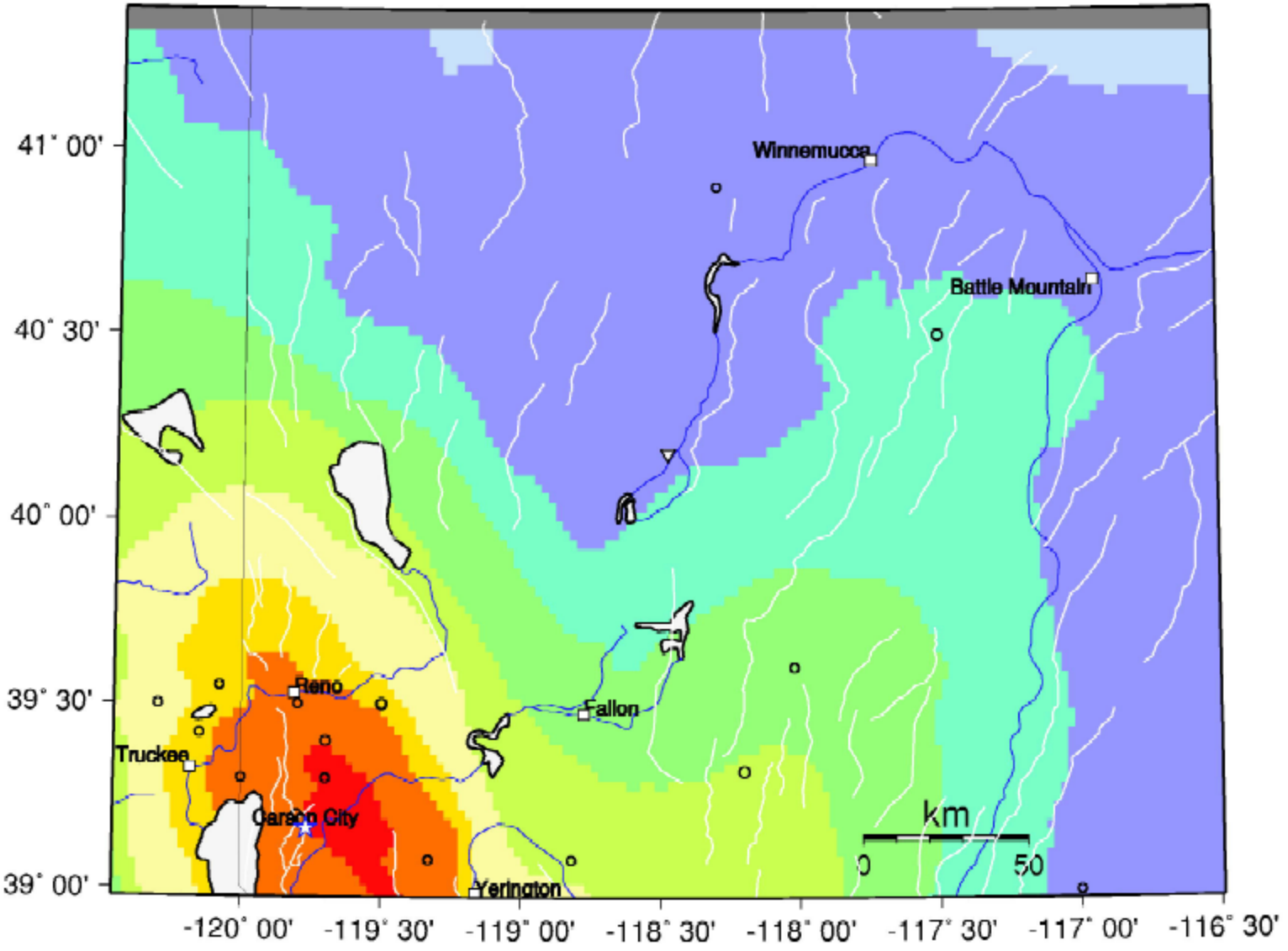
The probability of a magnitude 6.0 earthquake occurring within 50 km of Wells, Nevada within the next 50 years is approximately 9%.
It happened on 21 February 2008.



C. dePolo photo

USGS science for a changing world

The probability of a magnitude 6.0 earthquake occurring within 50 km of Lovelock within the next 50 years is approximately 10 to 20%, a bit higher than for Wells.



GMT May 4 09:07 | Earthquake probabilities from USGS 2002 PSHA. 50 km maximum horizontal distance. Site of interest: triangle. Fault traces are white; rivers blue. Epicenters M>=6.0 circles.

Earthquake faults occur throughout Nevada, and potential losses from earthquakes are high for many communities.

The consequences of earthquakes can be huge in Nevada, particularly if individuals are not prepared.

A. Be prepared to respond.

B. Mitigate structural risks, largely through building codes and avoiding faults and areas of liquefaction.

C. Mitigate nonstructural risks.

Unreinforced masonry building (URM) that collapsed during the Wells earthquake on 21 February 2008

View from back, 20 May 2009

View from front, 20 May 2009

Nonstructural damage often can be easily prevented.

Earthquake-secure bookshelves in the office of the State Geologist

Secured computers at the Clark County Building Department

Thank you!

And thanks to Gary Johnson, Christine Ballard, Heather Armeno, Irene Seeley, Linda D. Goar, and Jordan T. Hastings for their work on the open-file reports (OF 09-8 and 09-9), which are available as online documents at www.nbmg.unr.edu.

From there, go to online documents at http://www.nbmg.unr.edu/dox/dox.htm, then scroll down to OF 09-8 or 09-9. Link to the fault map from OF 09-9.

Nevada Bureau of Mines and Geology

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