

# Paradigms Lost: Geologic Thought as Driver of Exploration Success for Nevada Gold

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Nevada's size:

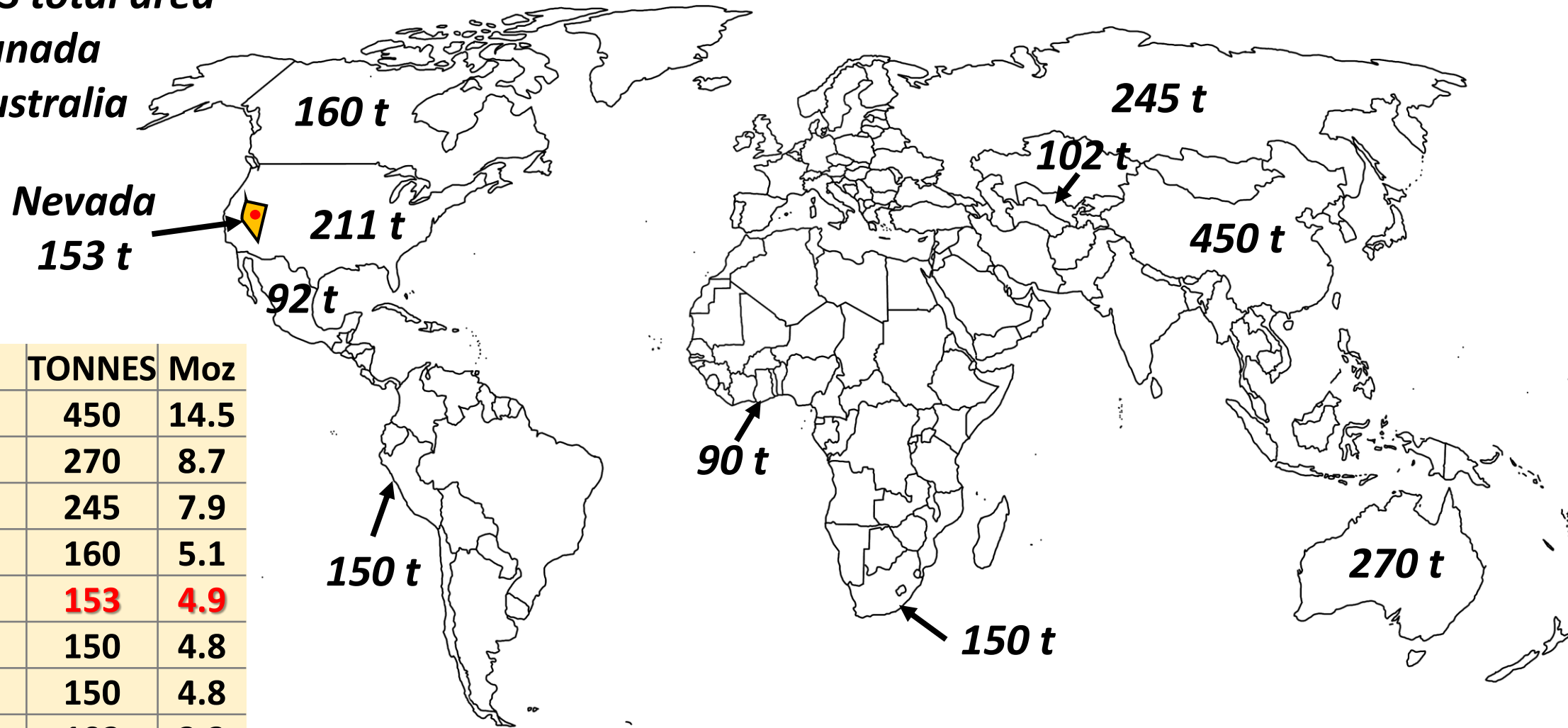
2.9% of U.S total area

2.9% of Canada

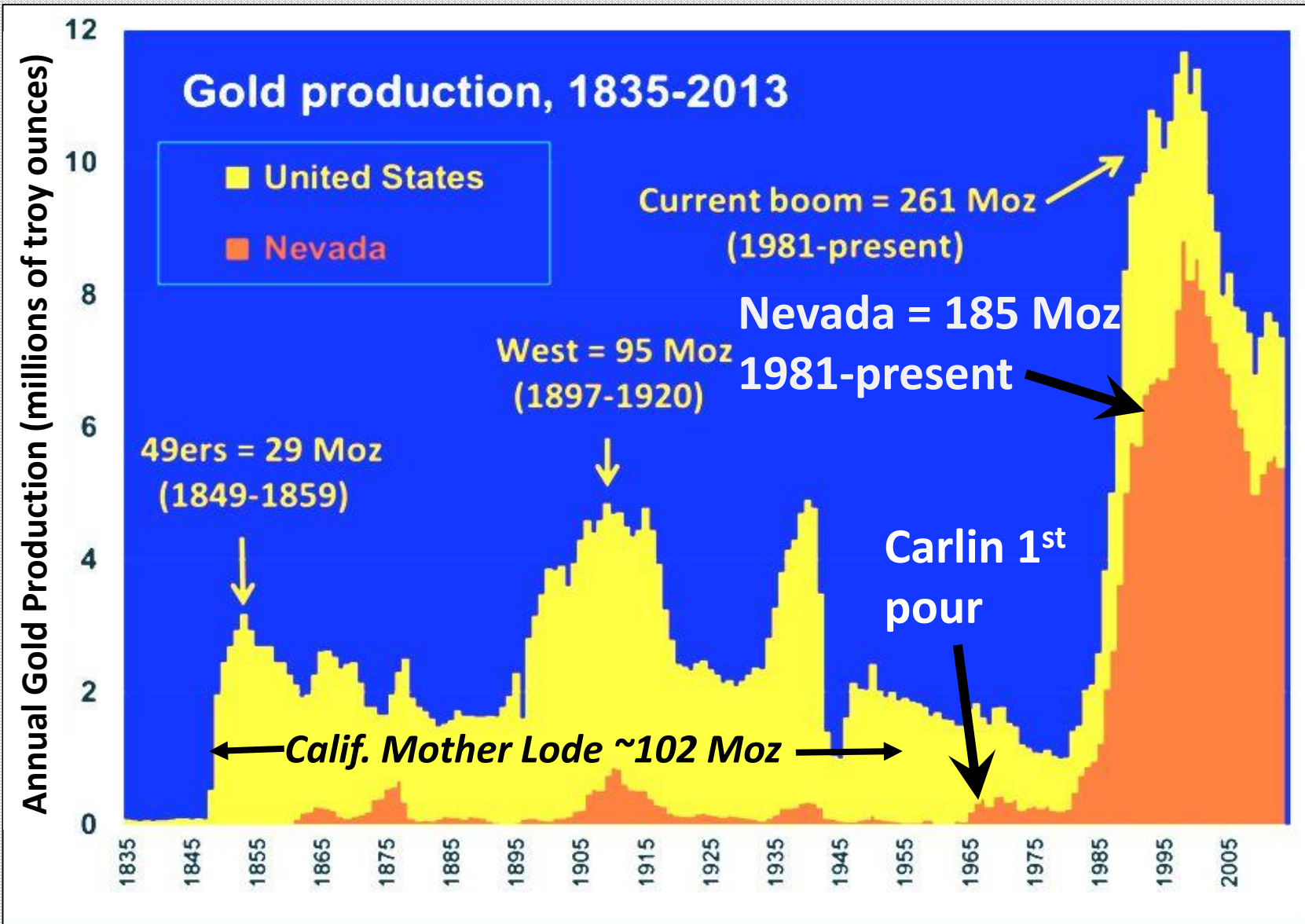
3.7% of Australia

# Top 10 Gold Producers - 2014

COUNTRY	TONNES	Moz
1. China	450	14.5
2. Australia	270	8.7
3. Russia	245	7.9
4. Canada	160	5.1
5. Nevada	153	4.9
6. South Africa	150	4.8
7. Peru	150	4.8
8. Uzbekistan	102	3.3
9. Mexico	92	3
10. Ghana	90	2.9



# Gold Production in the U.S. and Nevada



**Mother Lode and the 1<sup>st</sup> Gold Rush**

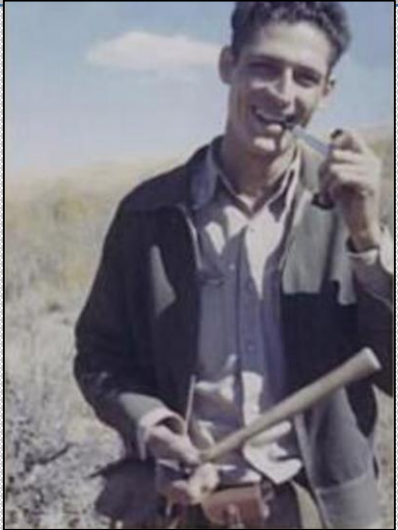
**Sustained CA production + new mines in the West**

**Current boom started modestly with the Carlin discovery**

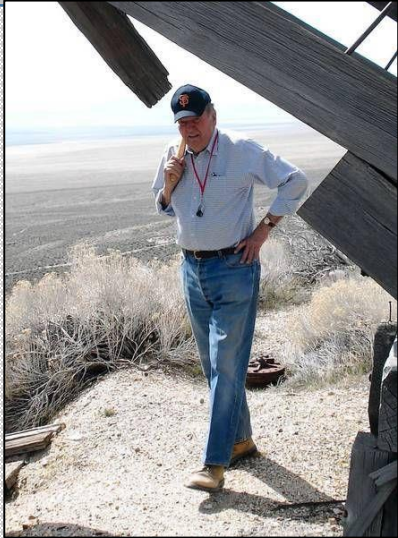
**Real trigger for new boom: Fixed Au price removed in 1971**

**Yesterday's waste became today's ore**

**Carlin discovery drove more discovery & innovation**



Ralph Roberts



John Livermore

## *Major innovations:*

*1. Recognition of the Antler orogeny and the regional Roberts Mountains thrust (Roberts, 1950s)*

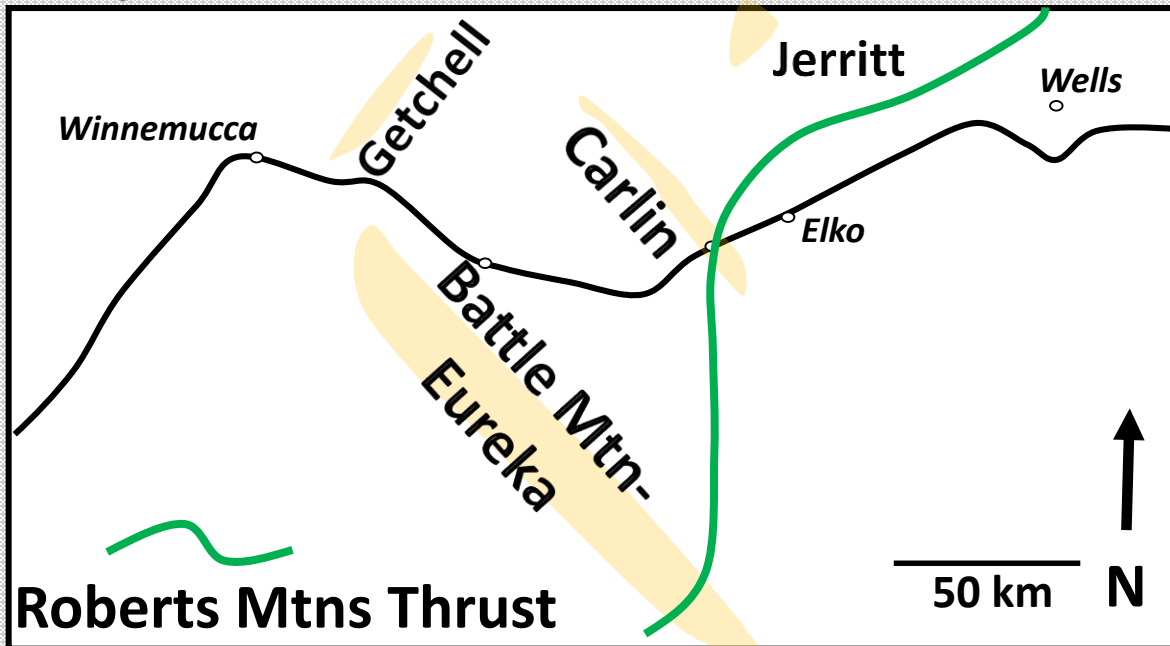
*2. Recognition of mineral trends (Roberts, 1960)*

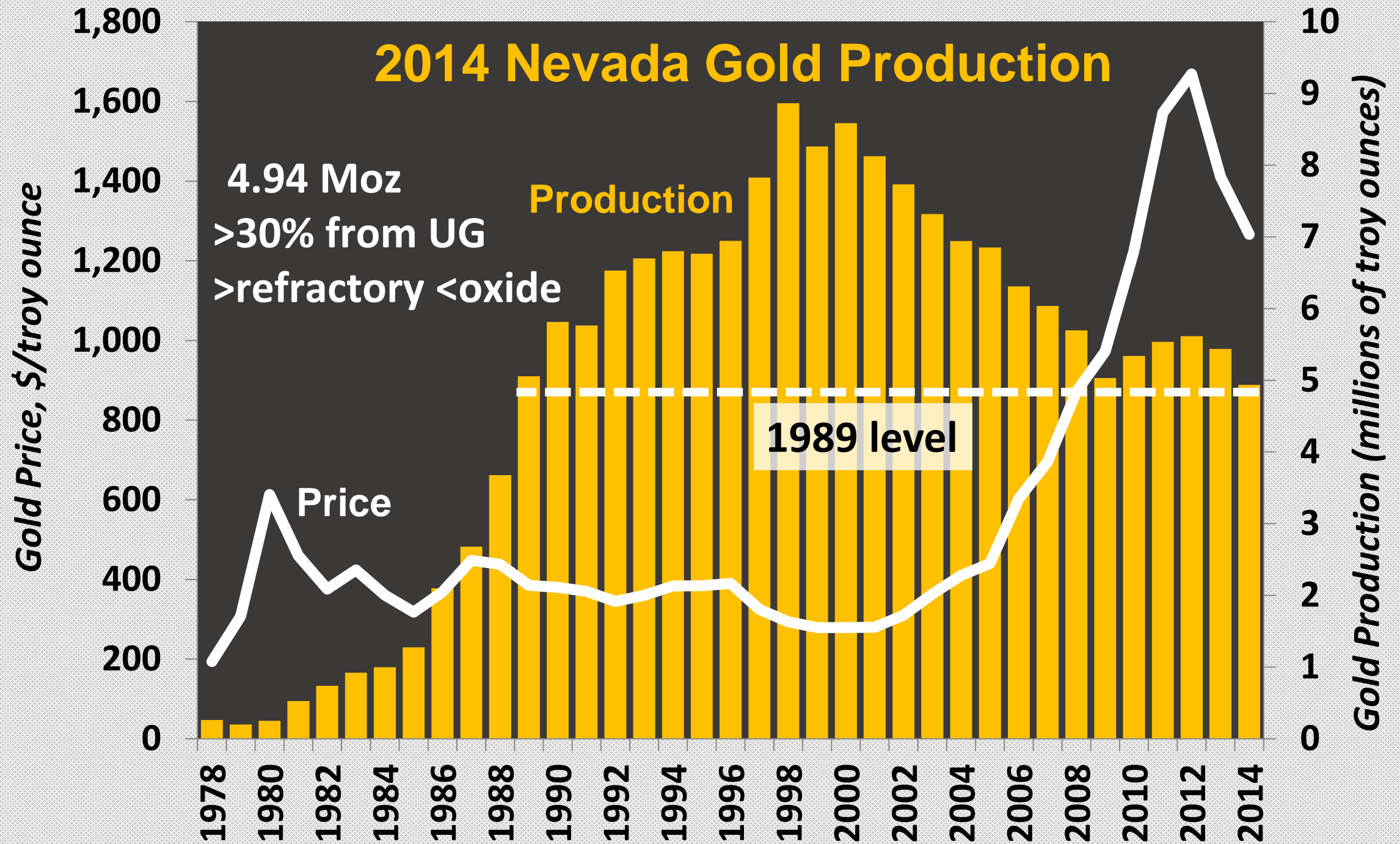
*3. “Invisible” Au at Carlin coincide with lower-plate windows*

*4. Heap leaching and bulk mining*

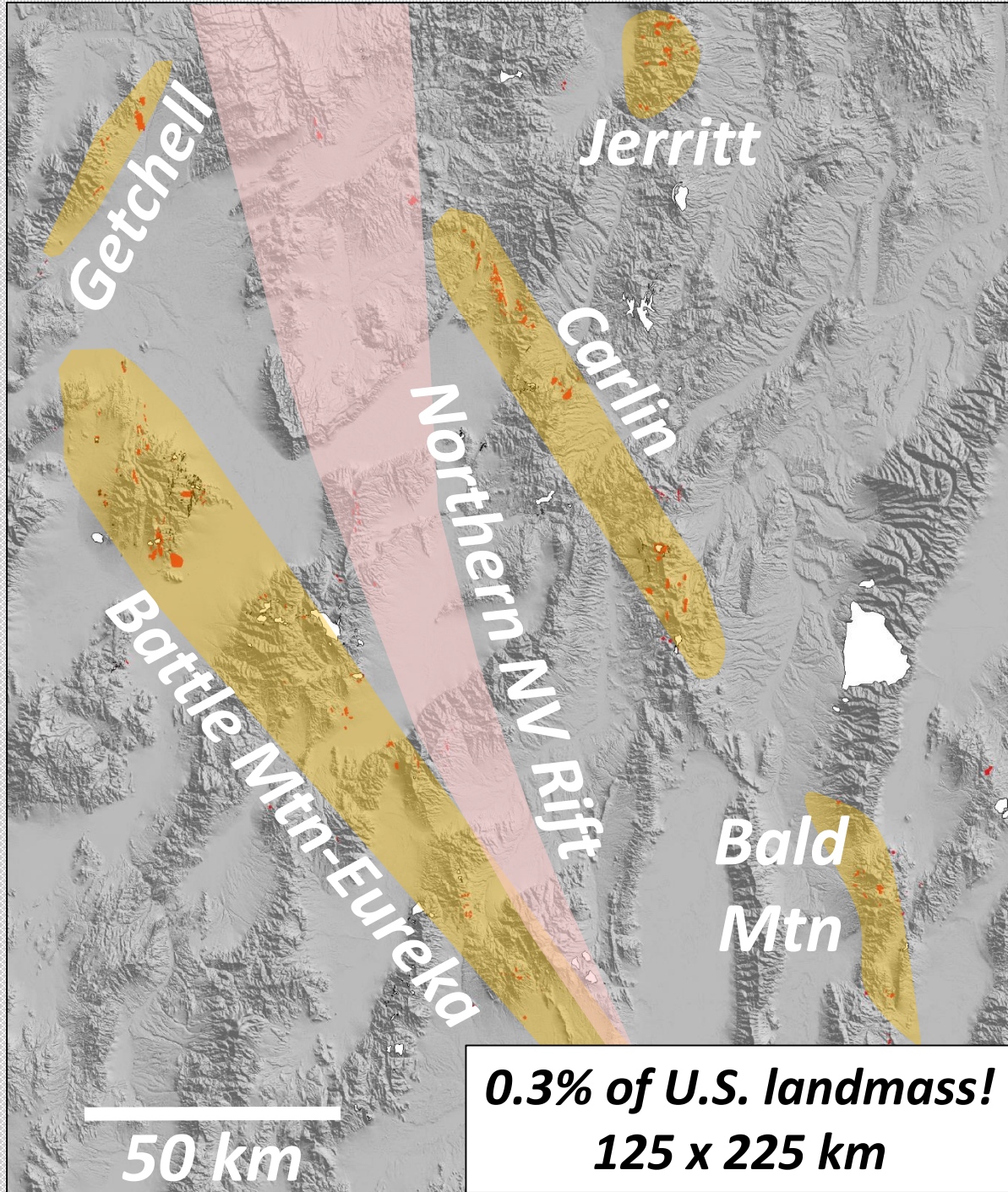
*5. Reverse-circulation drilling*

*6. Advent of rapid, low-detection geochemistry*









## Eocene Gold Belt Production

**Carlin: 91 Moz**

**Battle Mtn-Eureka: 35 Moz**

**Getchell: 22 Moz**

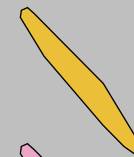
**Jerritt Canyon: 7 Moz**

**Bald Mountain: 3.5 Moz**

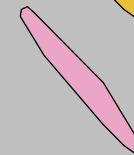
## Miocene Epithermal Belt

**Northern Nevada Rift: ~5 Moz**

**Total: ~163 Moz produced**



**Eocene Gold Belt**



**Miocene Au-Ag Belt**

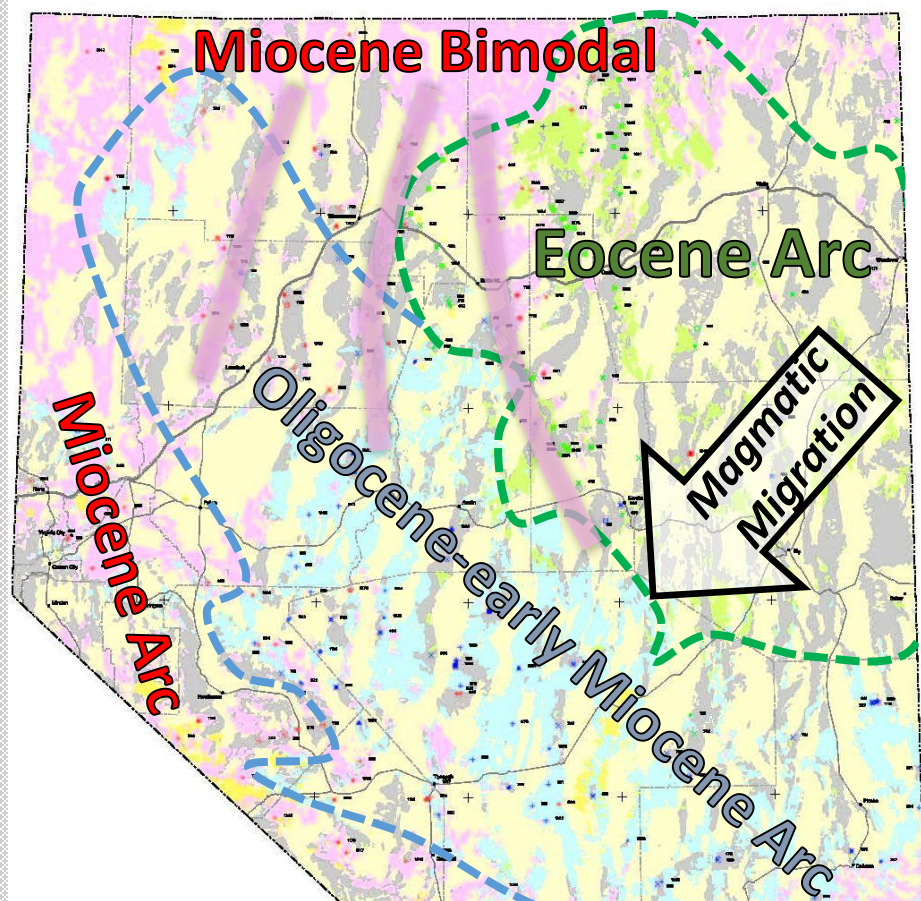


**Deposit**



**Eocene Intrusion**





### Cenozoic Igneous Rocks of Nevada

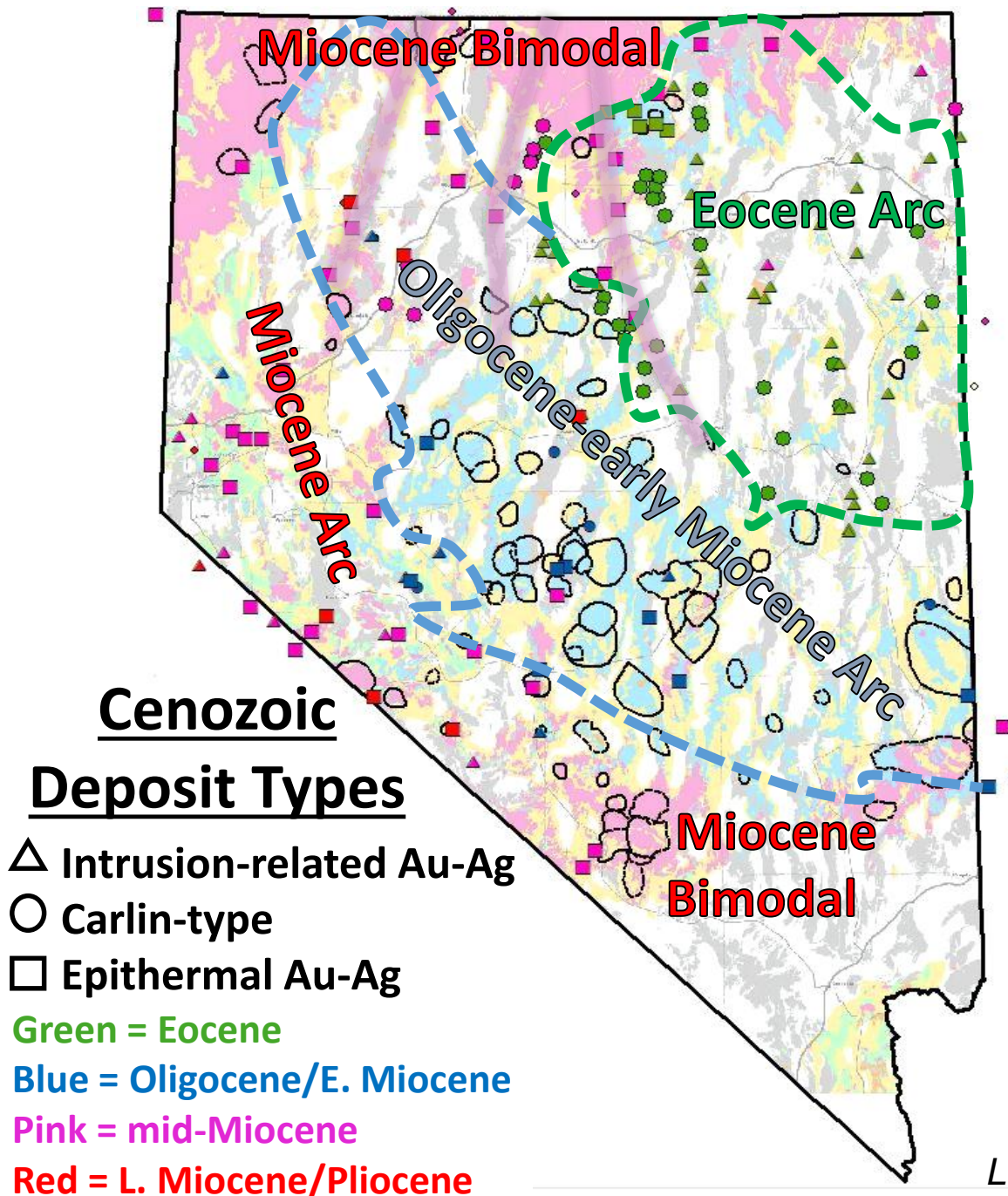
Basalt-rhyolite (**Mid-Miocene**; rift-related)  
 Andesite-dacite (**Mid-Miocene** arc-related)

**OLIG-MIO-** Rhyolite-dacite pyroclastics  
 arc-related)

**EOCENE-** Andesite-dacite-rhyolite  
 lava/intrusions

## *What's so special about the Eocene?*

- *Carlin-type deposits coincide spatially and temporally with Eocene magmatism*
- *Heat source, possible metal source*
- *Eocene magmatism followed a ~40-50 Ma hiatus*
- *Characterized by rapid SW migration: 30-70 km/m.y.*
- *Later magmatism related to slower rollback*



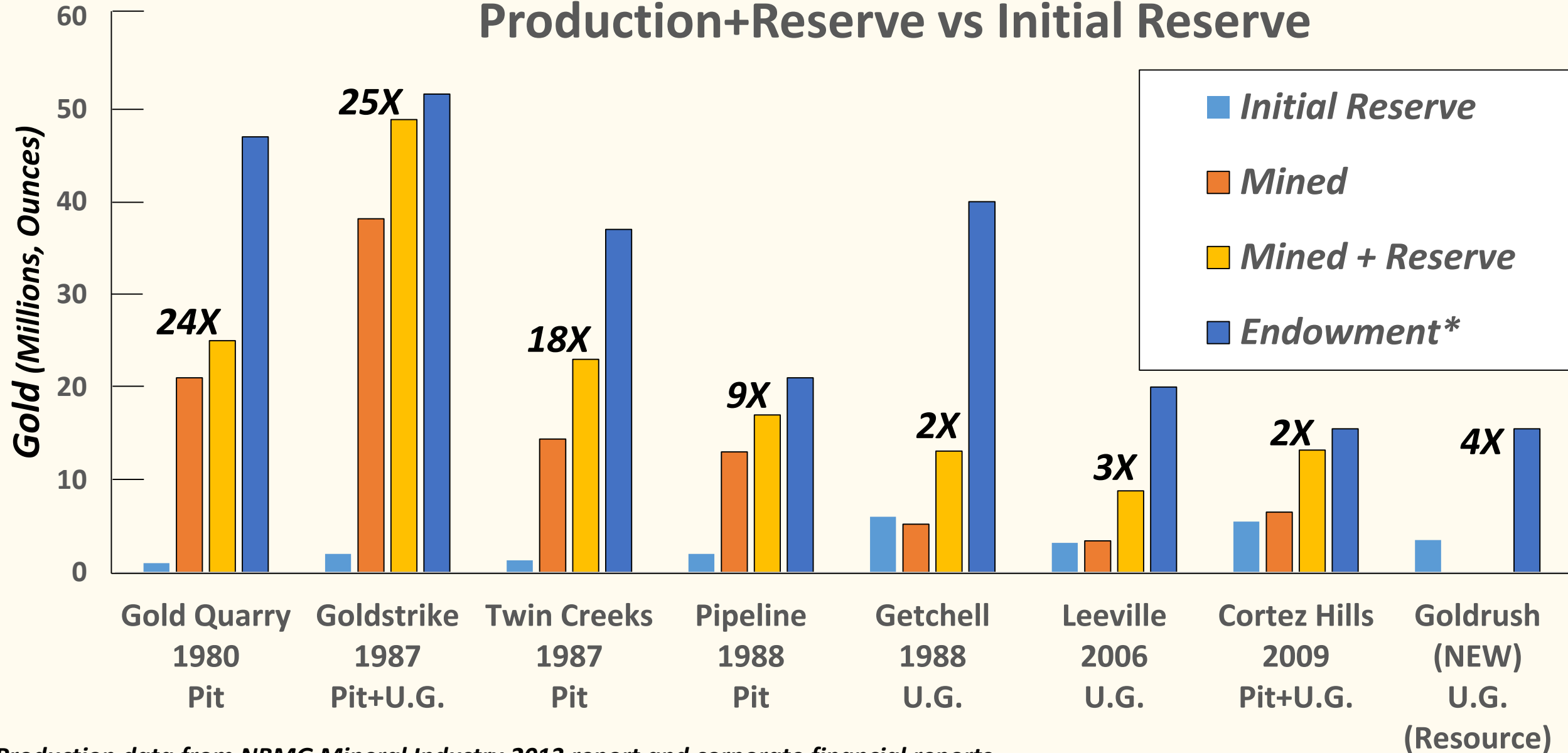
## ***Eocene: Sweet Spot for Carlin-type***

- ***Eocene metallogeny: Au-dominant Carlin-type Au (major)***  
***Distal disseminated Au***  
***Au skarn***
- ***Other periods have more typical magmatic-hydrothermal deposits: epithermal, porphyry***
- ***What's special about Carlin-types?***  
***Trends/clusters=large systems***  
***Replacement style=large tonnage***  
***But, often high grade too***



# Growth History of Nevada Carlin Gold Giants

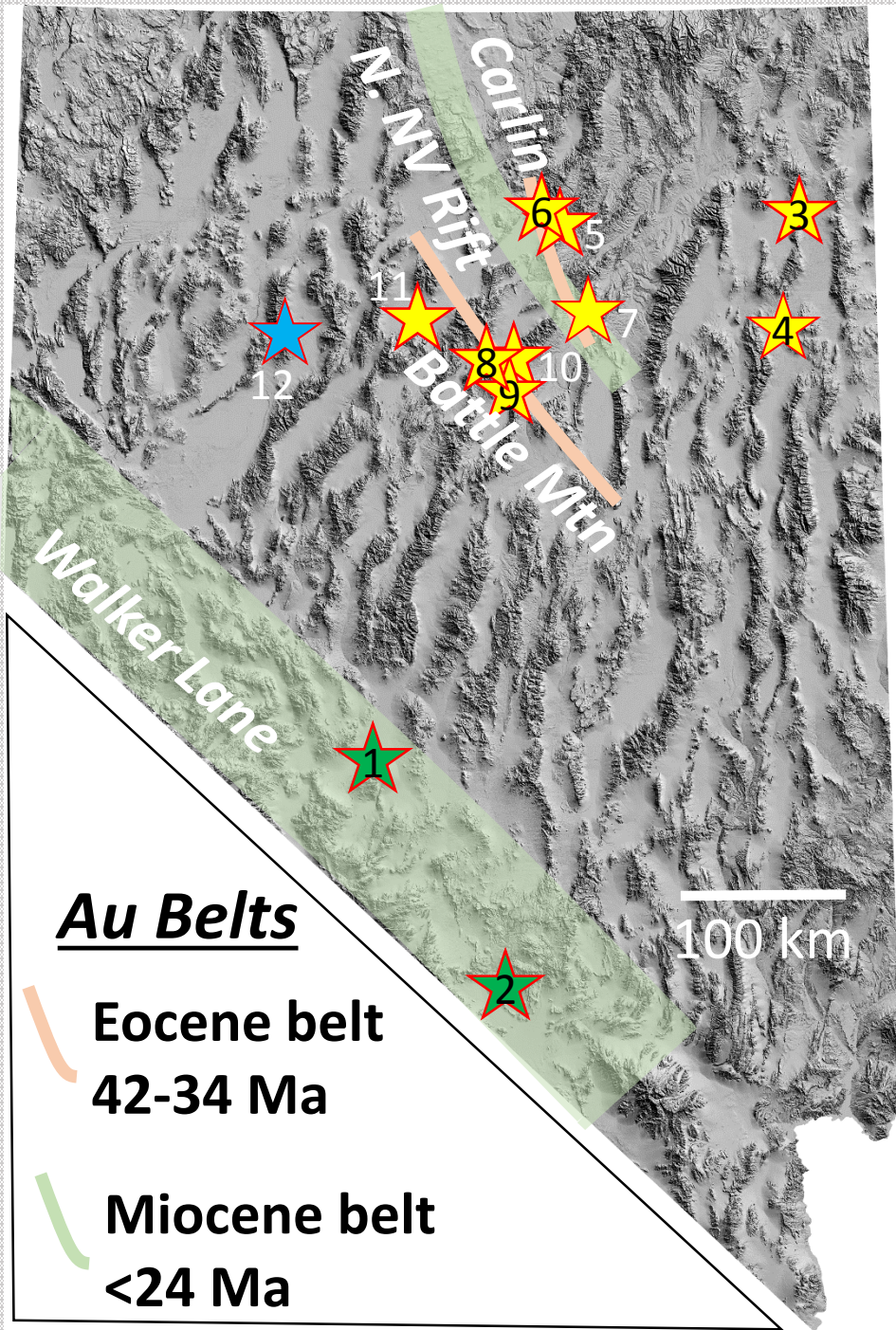
## Production+Reserve vs Initial Reserve



*Production data from NBMG Mineral Industry 2013 report and corporate financial reports*

*\*Endowment estimates from historic data, corporate presentations, publications; includes unclassified, mineralized material*

# Selected Discoveries



1. Eastside – Columbus Gold-Cordex (2011-13)
2. N. Bullfrog – Redstar-Corvus Gold (2011-13)
3. Long Canyon – Pittston/AuEx (1999-2003)
4. Kinsley – Pilot Gold (2012-13)
5. Leeville corridor – Newmont (1994 initial)
6. Arturo – Barrick-Meridian (1998-2005)
7. N. Bullion – Gold Standard (2010-11)
8. Cortez Hills – Cortez JV (2002-2003)
9. Iceberg – NuLegacy Gold (2012)
10. Goldrush – Barrick (2011)
11. Helen/2201 – Victoria Gold/Premier (2007-14)
12. Spring Valley – Echo Bay/Midway (1999-2003)

- ★ Miocene epithermal
- ★ Eocene Carlin-type
- ★ Cretaceous orogenic

# When Were Nevada Discoveries Made?

Late Boom/Early Bust

1994-2003

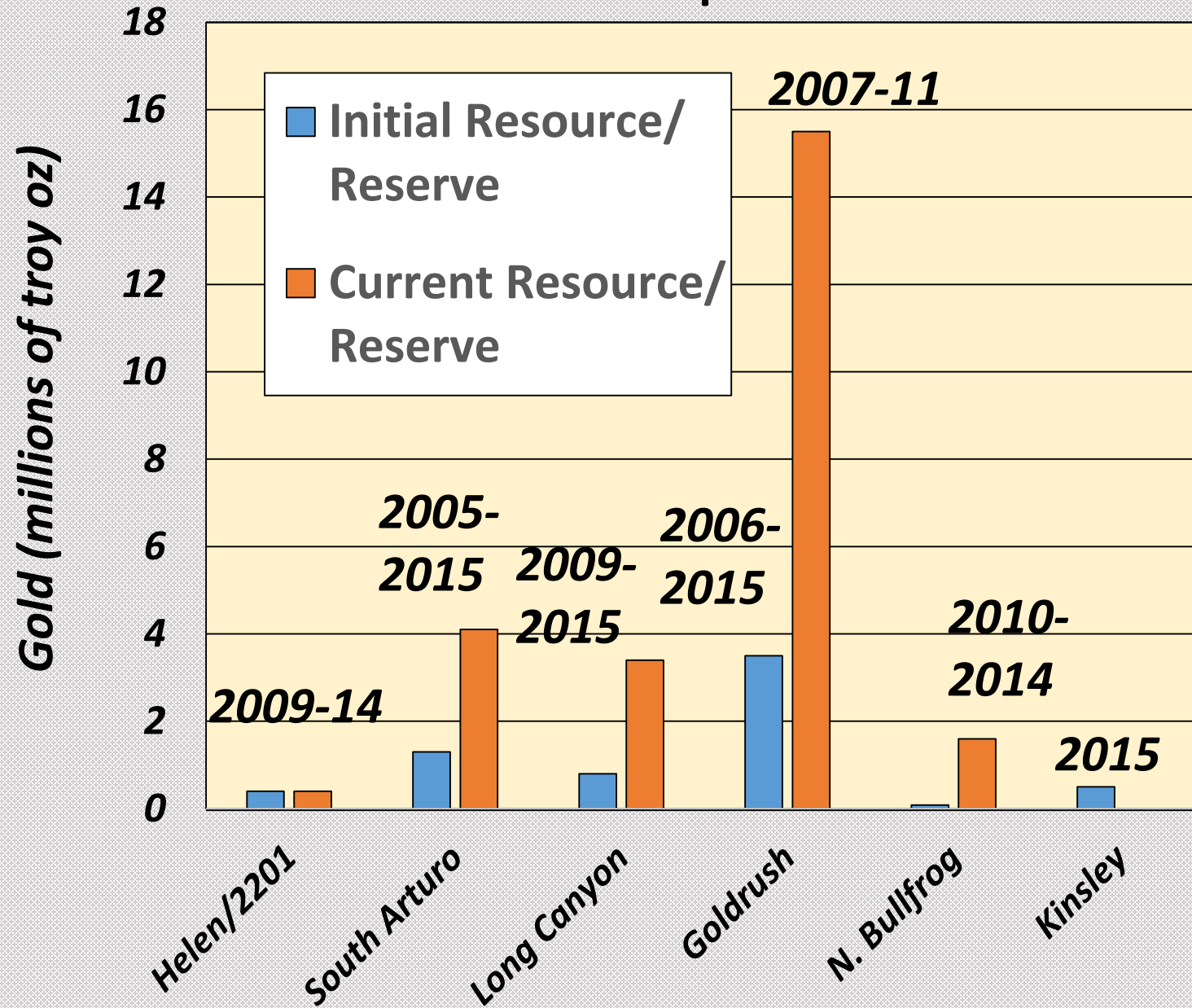
• Leeville corridor	post-1994	Newmont	Mining	
• South Arturo	1999-2005	Barrick	Mining	
• Spring Valley	1999-2000	Echo Bay	Prefeasibility??	Resource
• Long Canyon	2000	Pittston (Junior)	Mining	
• Cortez Hills	2002-2003	Cortez JV (majors)	Mining	

2011-2013

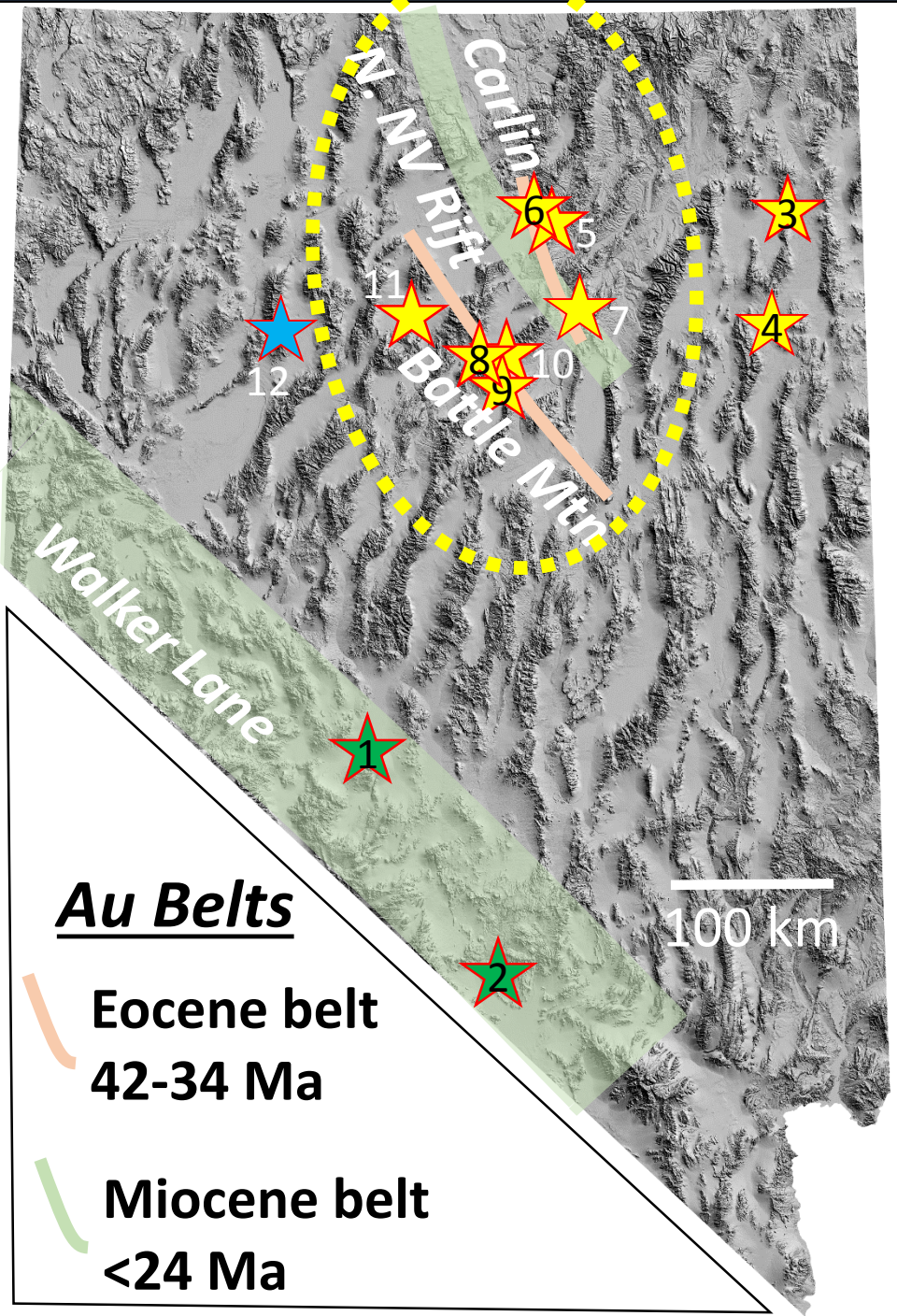
• Helen/2201	2007	Victoria (Junior)	Exploration	Res
• Goldrush	2009/10	Barrick	Prefeasibility	MII
• North Bullion	2010/11	Gold Standard (Jr)	Exploration	No Res
• North Bullfrog	2011/12	Corvus Gold (Junior)	Exploration	M+I+I
• Kinsley	2012/13	Evolving Gold (Jr)	Early Exploration	Ind+Inf
• Iceberg	2012	NuLegacy (Junior)	Early Exploration	No Res



## Recent Discoveries and Resource Expansion



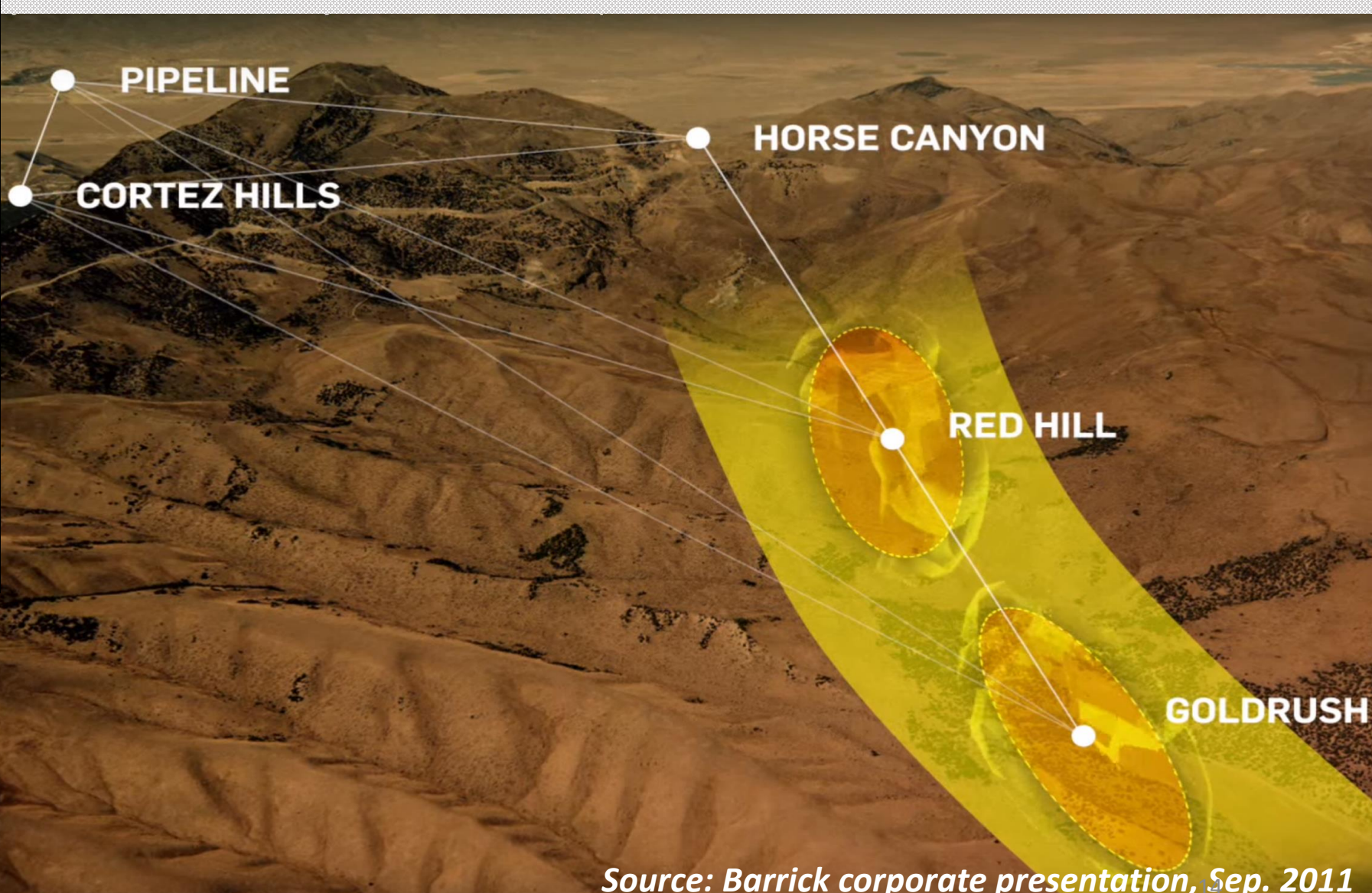
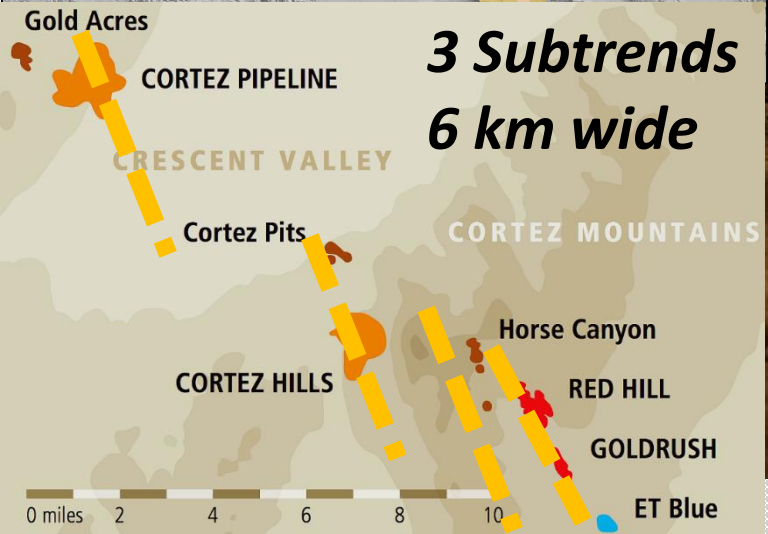
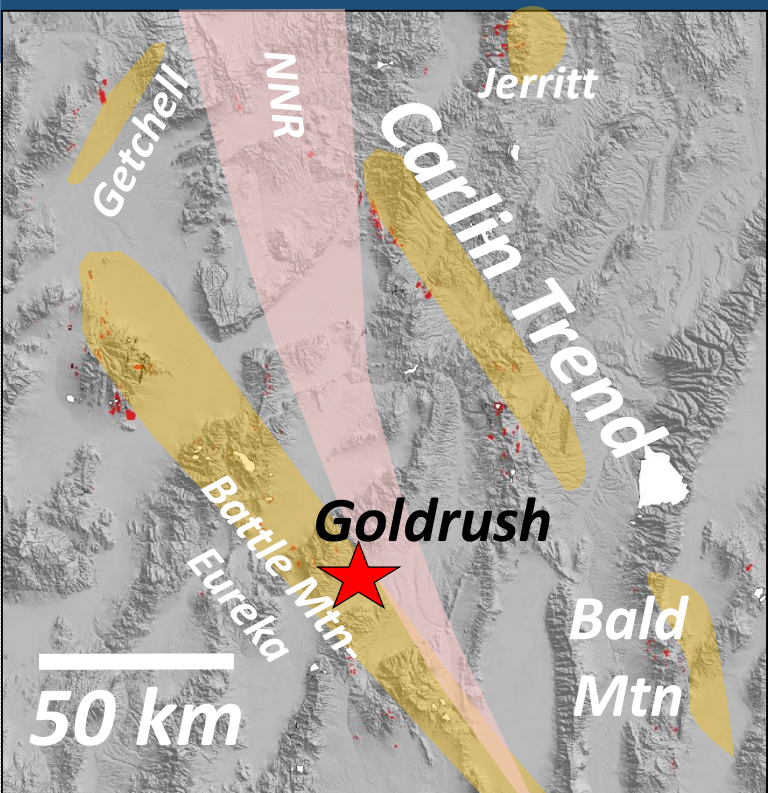
- *5 of 6 notable resources in the recent past are from Carlin-type deposits*
- *1 low-sulfidation epithermal*
- *Most show the desirable trend of rapid increase in resource ounces despite mining downturn*
- *Newer discoveries discovered after the 'financial meltdown'*
- *Expect similar increases in resources to established deposits*



# North-central Nevada

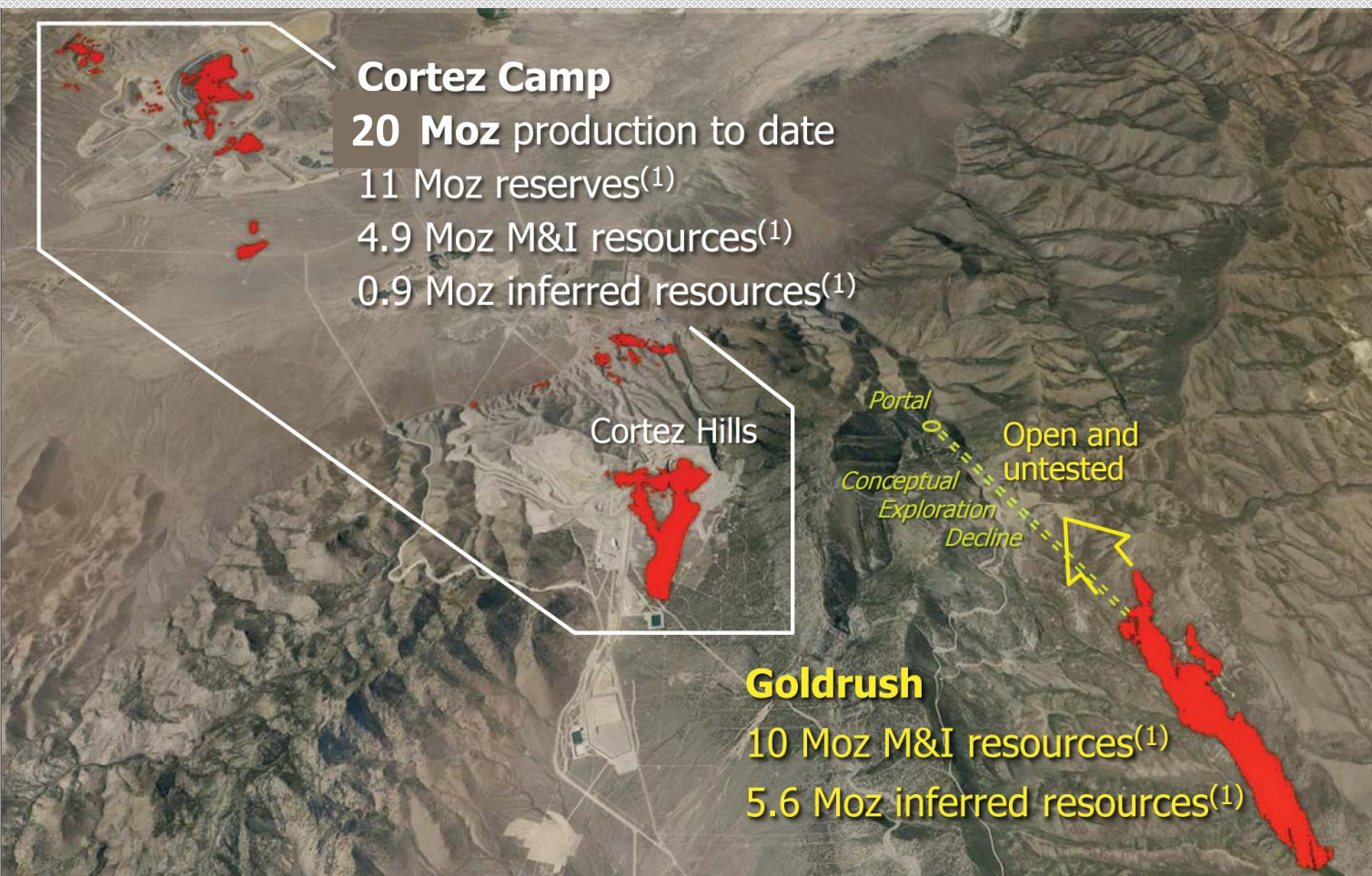


# Barrick's Goldrush Discovery: The Right Address



Source: Barrick corporate presentation, Sep. 2011





- ***Most significant discovery since Cortez Hills in 2002***
- ***Original Red Hill discovery by Placer Dome (61m @ 8.2 g/t)***
- ***Goldrush was discovered 2km south of Red Hill in 2009***
- ***Headframe exploration: 6 km from Cortez Hills***
- ***3 parallel subrends, 6 km wide***



# Barrick's Goldrush Discovery: The Right Stuff!



**2009 discovery: 70 ft @ 0.89 opt Au (21.3 m @ 30.5 g/t)**

**2011 discovery announcement with ~3.5 Moz MII**

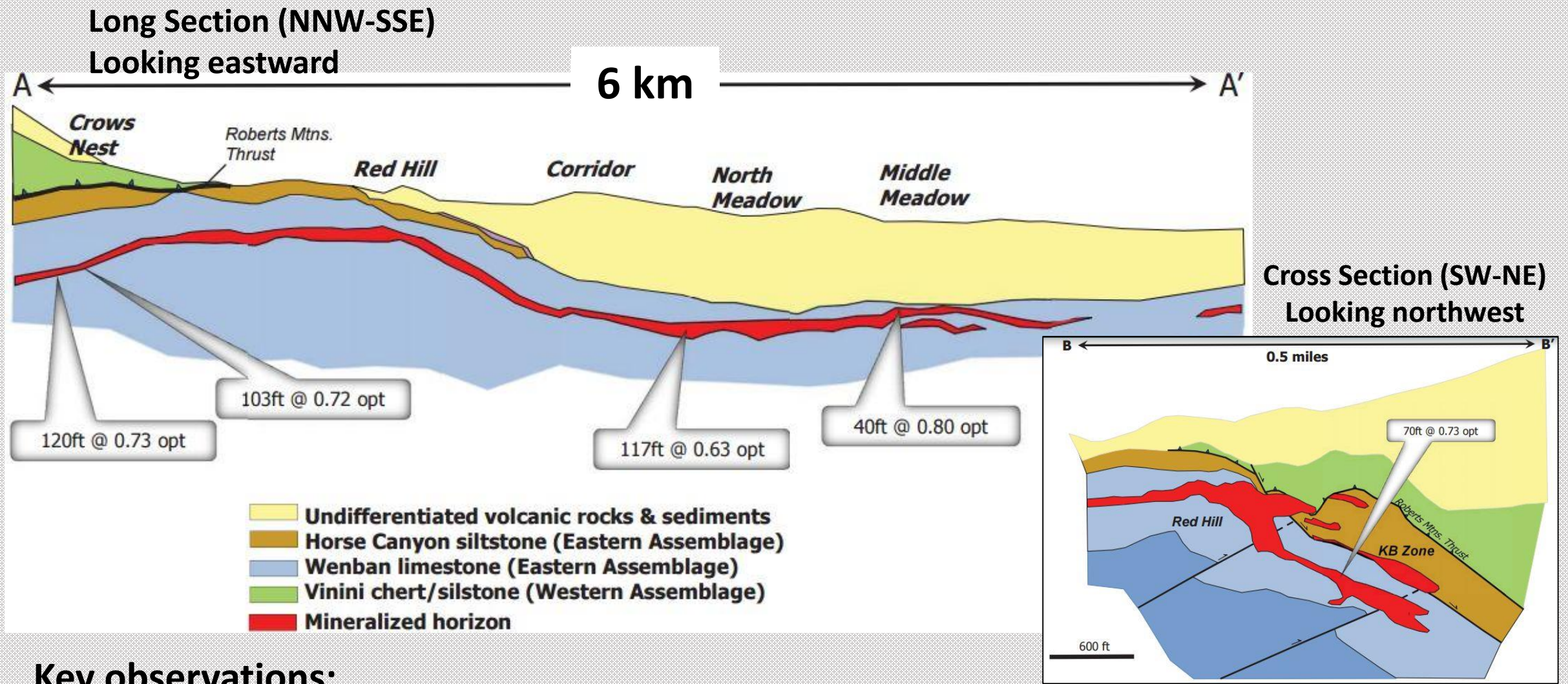
**2012: ~7 Moz MII**

**2015: 15.5 Moz MII; pre-feasibility**

**Key Points Leading to Discovery:**

- Aggressive exploration program – elephant country, Placer Dome discovery of Cortez Hills
- Recognition of parallel structural corridor – curiously subparallel to edge of Northern Nevada Rift
- Structural & stratigraphic expertise: distinction of upper and lower plates, recognition of receptive host rocks



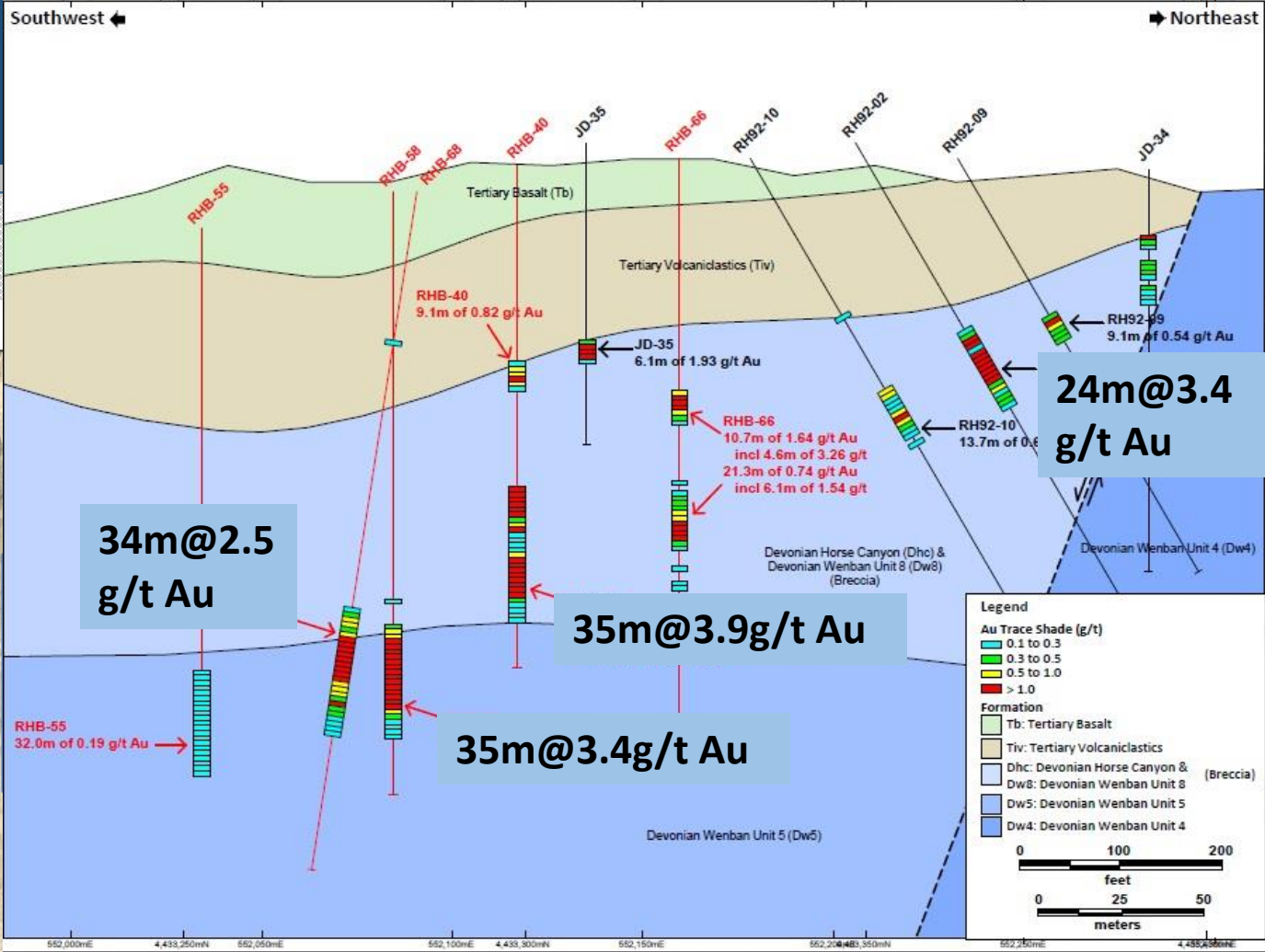
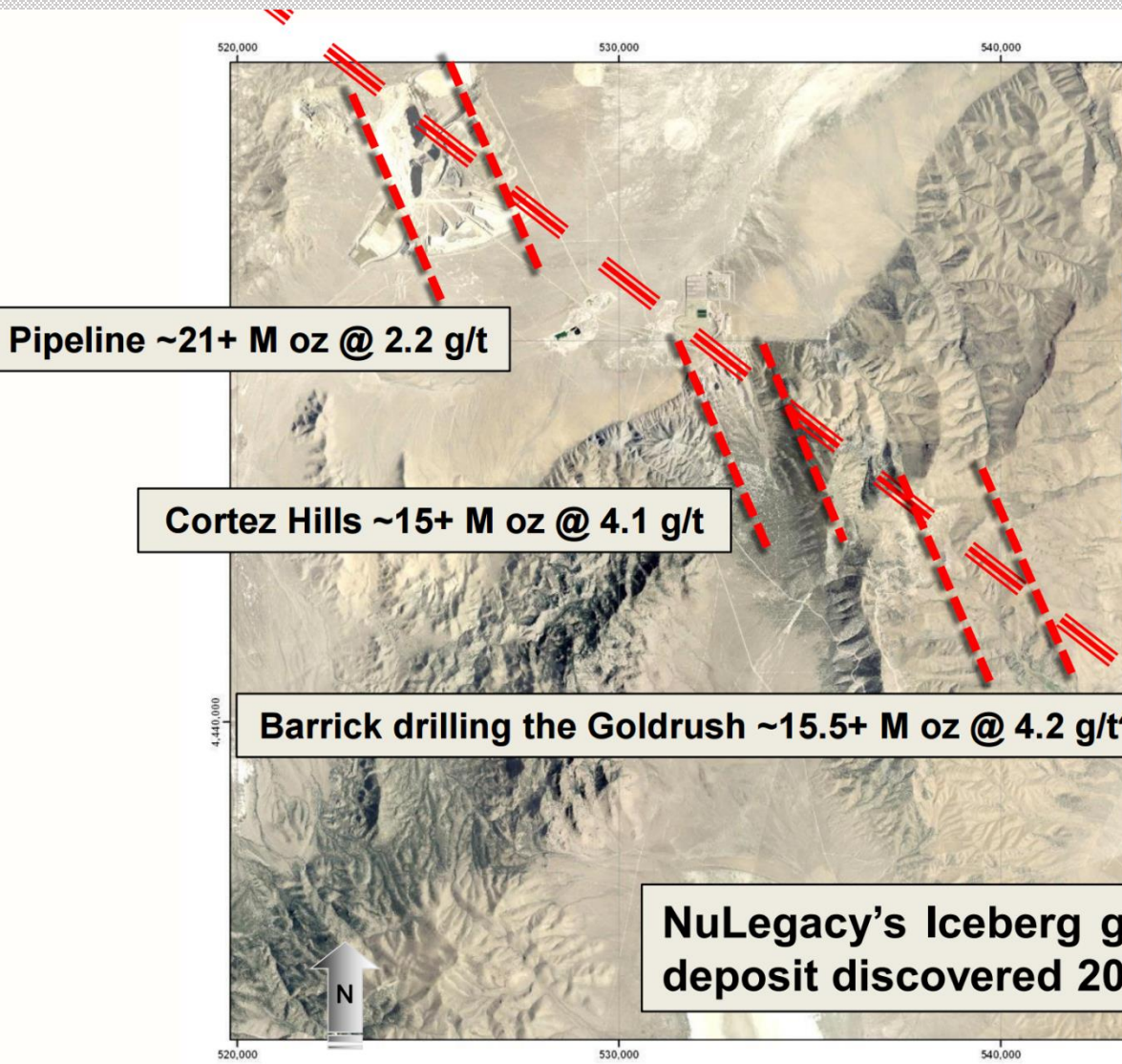


### Key observations:

- Re-analysis of stratigraphy and recognition of prospective lower-plate lithologies at shallow depth
- Recognition of another parallel structural trend: Cortez Hills, Horse Canyon, Goldrush
- Roberts Mountains thrust in hanging wall



# NuLegacy Gold - Iceberg



## ***Conclusions on Innovation in Nevada***

**Nevada represents a huge step change in geologic thinking that contributed directly to the current long-lived production boom**

**Generating and testing geologic concepts are the engine of exploration and innovation**

**Discoveries and innovations came in many different forms, and these continue to redefine the exploration model for Nevada deposits**

**Economic discoveries often come during down cycles: desperation is a mechanism of creativity**

**New technologies are very important especially when applied to situations where a good geologic framework already exists. Technologies should be 'fit for purpose'.**