New Age Constraints On Middle To Late Cenozoic Plutons In The Western San Juan Mountains, Southwestern Colorado: Implications For Landscape Evolution

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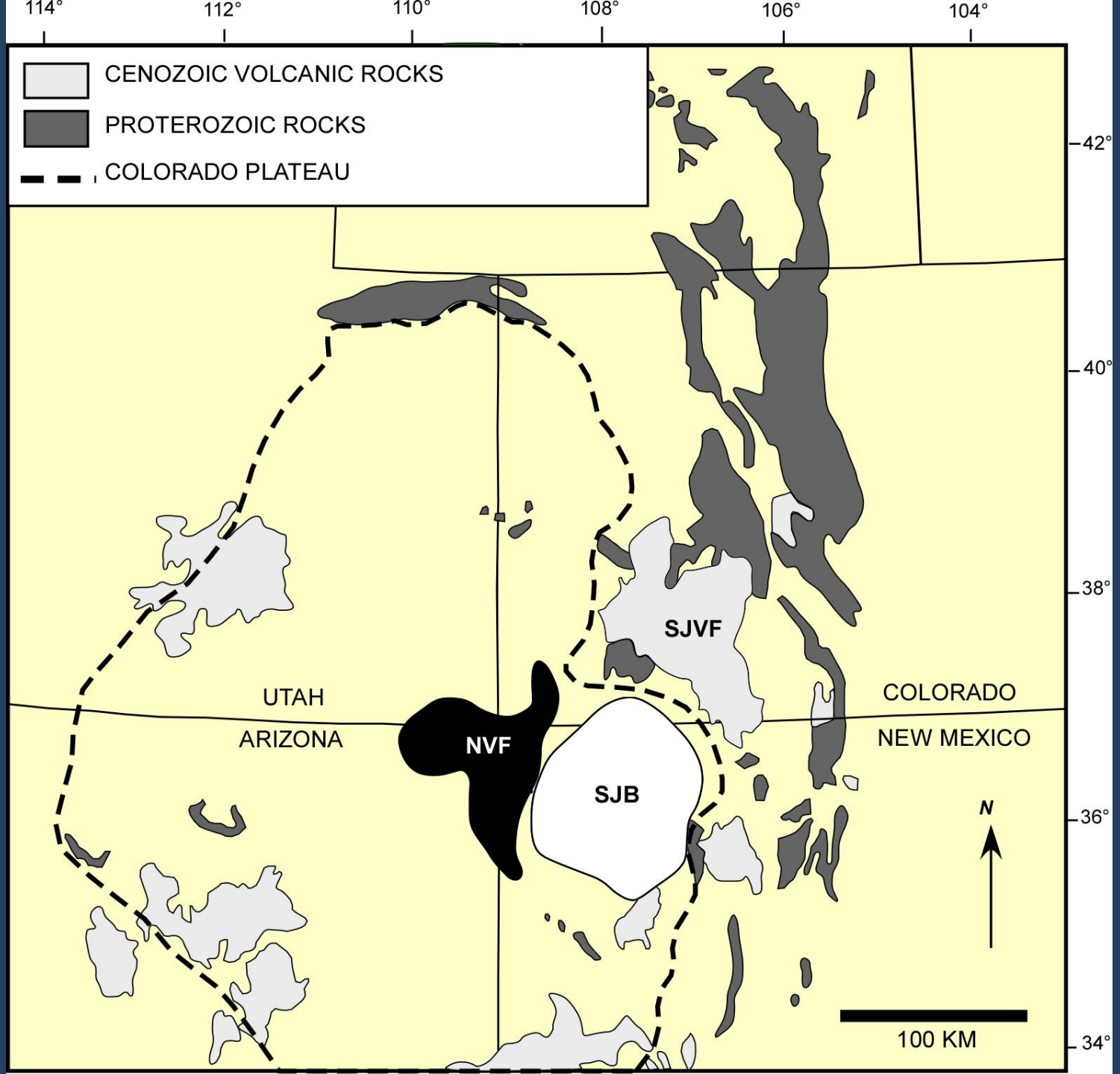
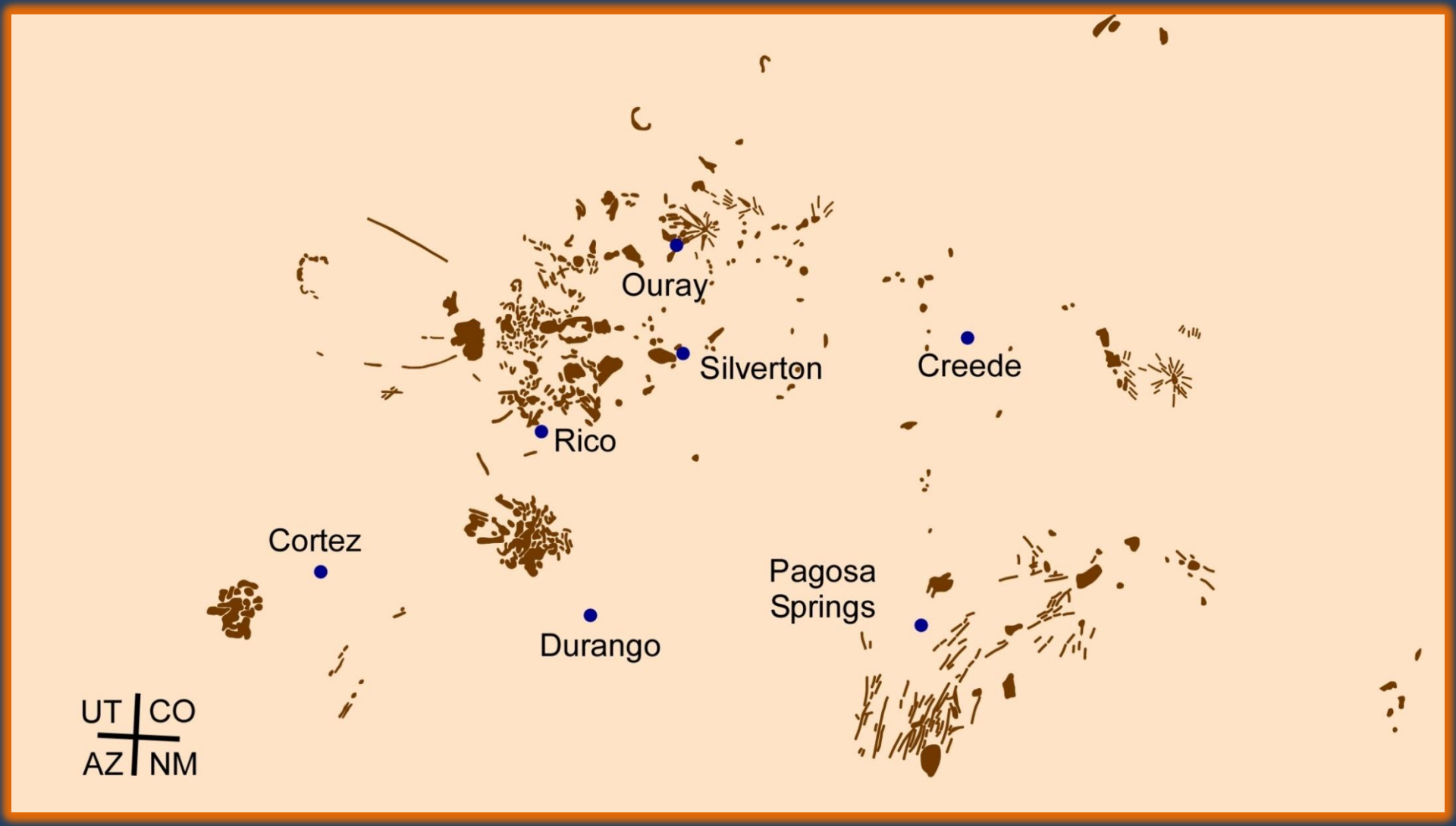

114°
112°
110°
108°
106°
104°
42°
40°
38°
36°
34°
CENOZOIC VOLCANIC ROCKS
PROTEROZOIC ROCKS
COLORADO PLATEAU
SJVF
UTAH
ARIZONA
NVF
SJB
COLORADO
NEW MEXICO
N
100 KM

Regional Distribution of Cenozoic Plutonic Rocks



Modified from Cunningham et al., (1994)

Motivation for Research

Chronology of Cenozoic plutonic record is poorly constrained but important in understanding:

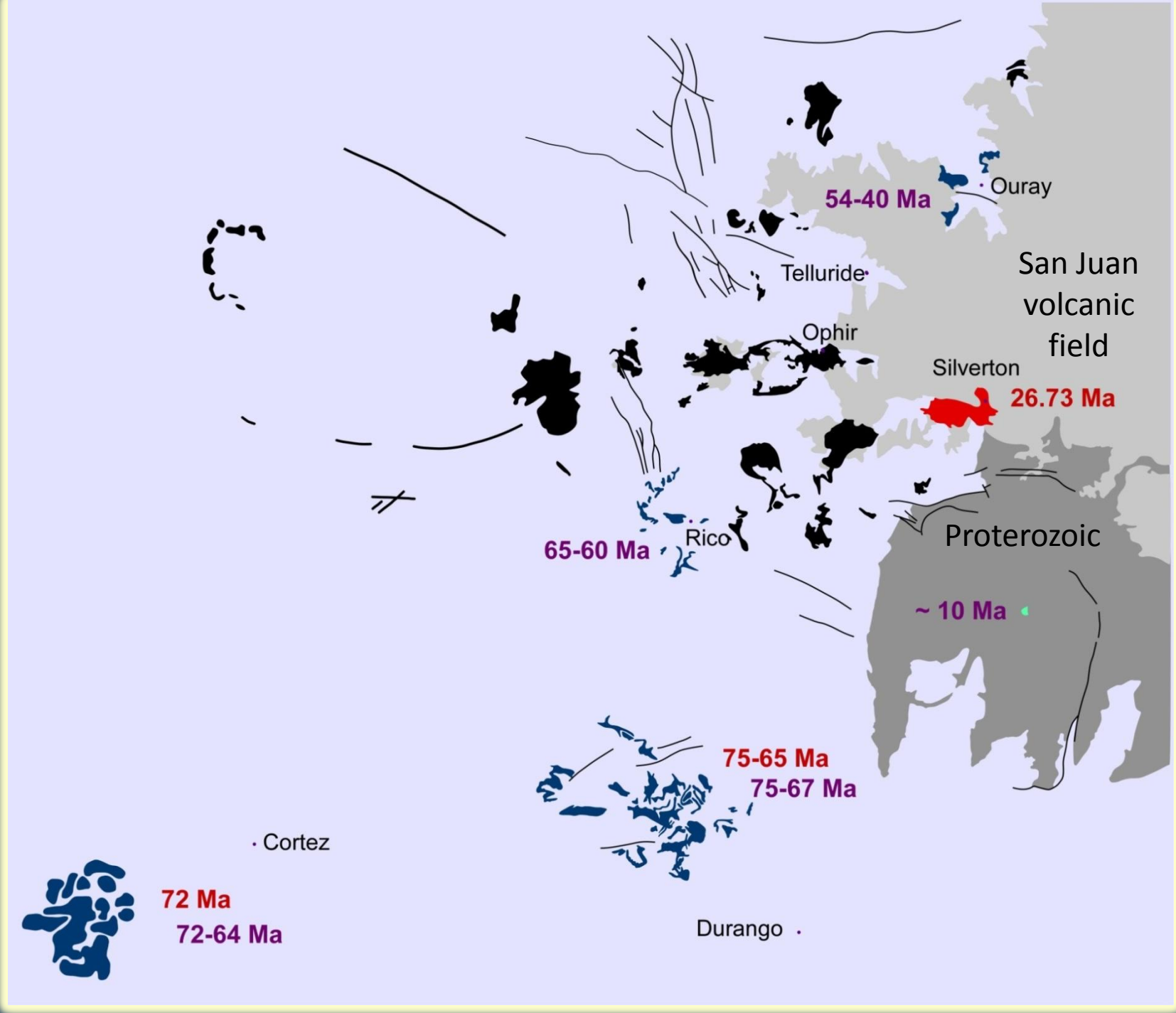
- Magmatic history of region
- Landscape evolution
- Relationship of magmatism & mineralization

Previous Data

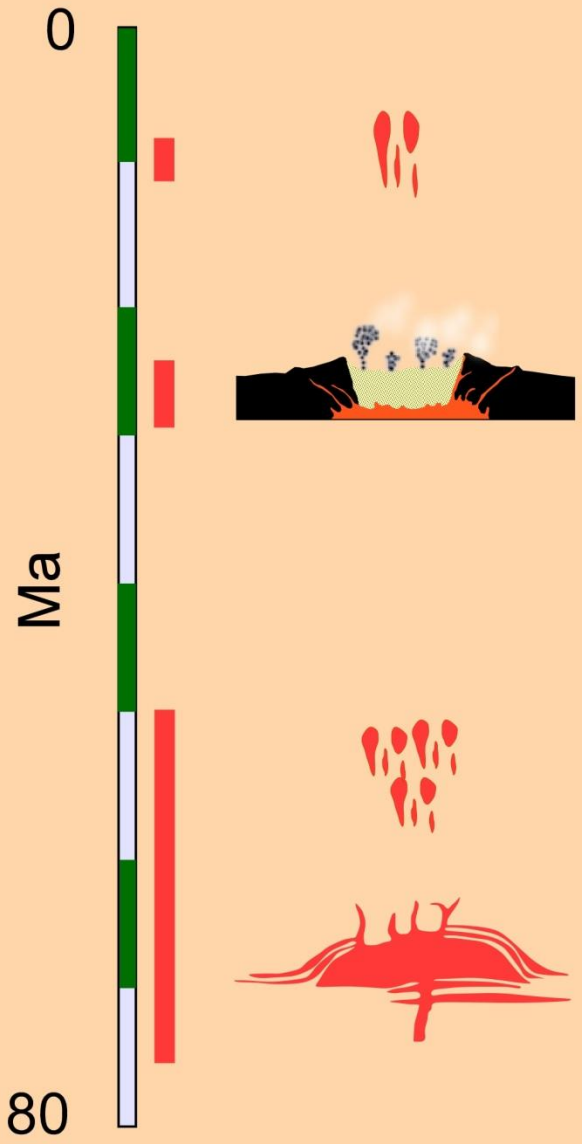
- Cunningham et al., (1994): Fission-track analyses on apatite, feldspar, and zircon + some K-Ar analyses provide some age constraints on crystallization and thermal resetting.

- Bove et al., (1999): Ar-Ar analyses on some volcanic and intrusive rocks.

- Many intrusive rocks had no prior age constraints.


54-40 Ma
Ouray
Telluride
San Juan
volcanic
field
Ophir
Silverton
26.73 Ma
Proterozoic
65-60 Ma
Rico
~ 10 Ma
75-65 Ma
75-67 Ma
Cortez
72 Ma
72-64 Ma
Durango

Previous Constraints on Timing of Cenozoic Magmatism in Western San Juan Mountains

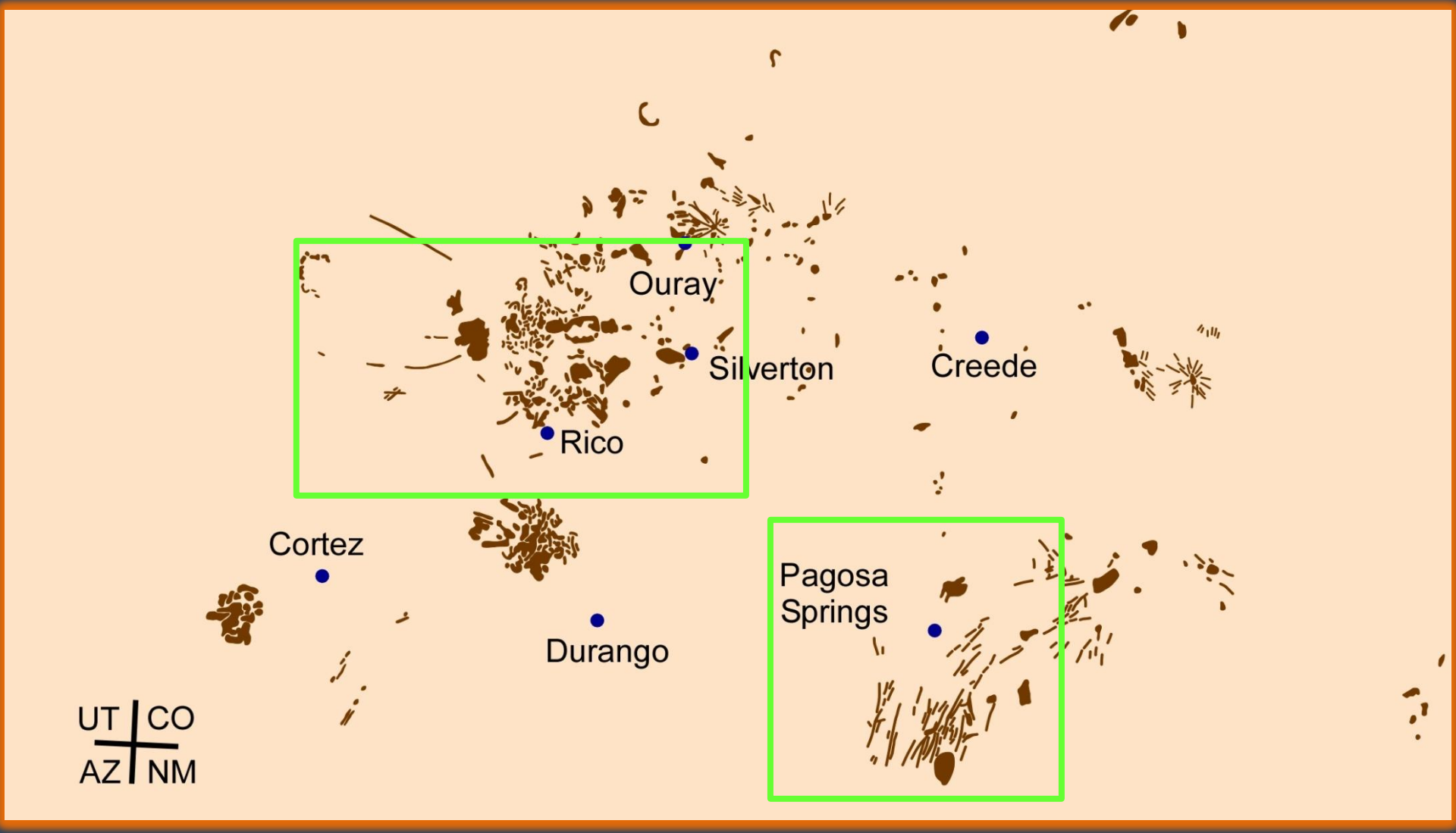


~10 Ma at one location

28 to 25 Ma: calk-alkaline to alkaline felsic to intermediate intrusive rocks related to San Juan volcanism.

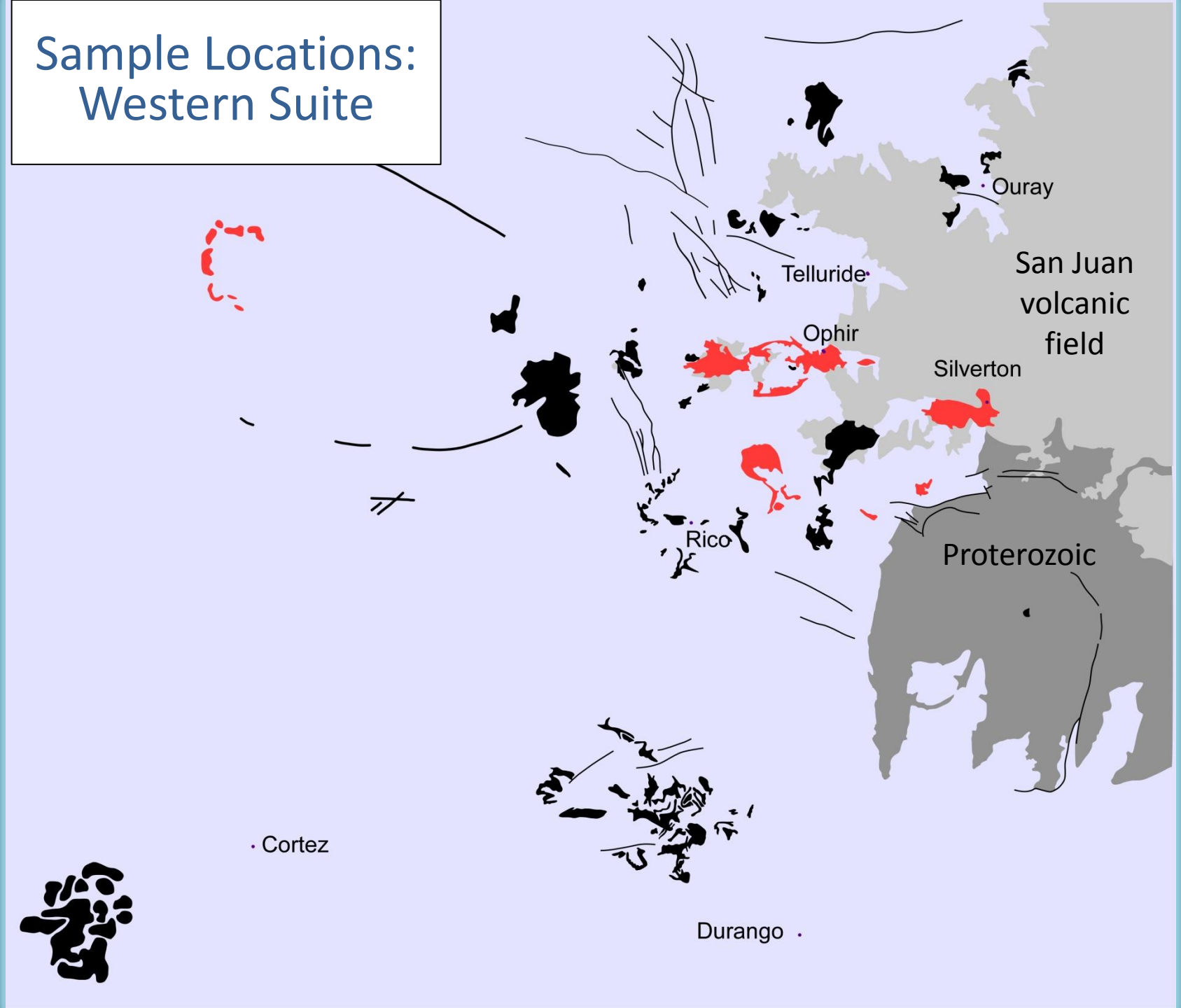
75 Ma to 50 (?) Ma: alkaline felsic to intermediate magmas formed laccolithic intrusions.

Areas of Research

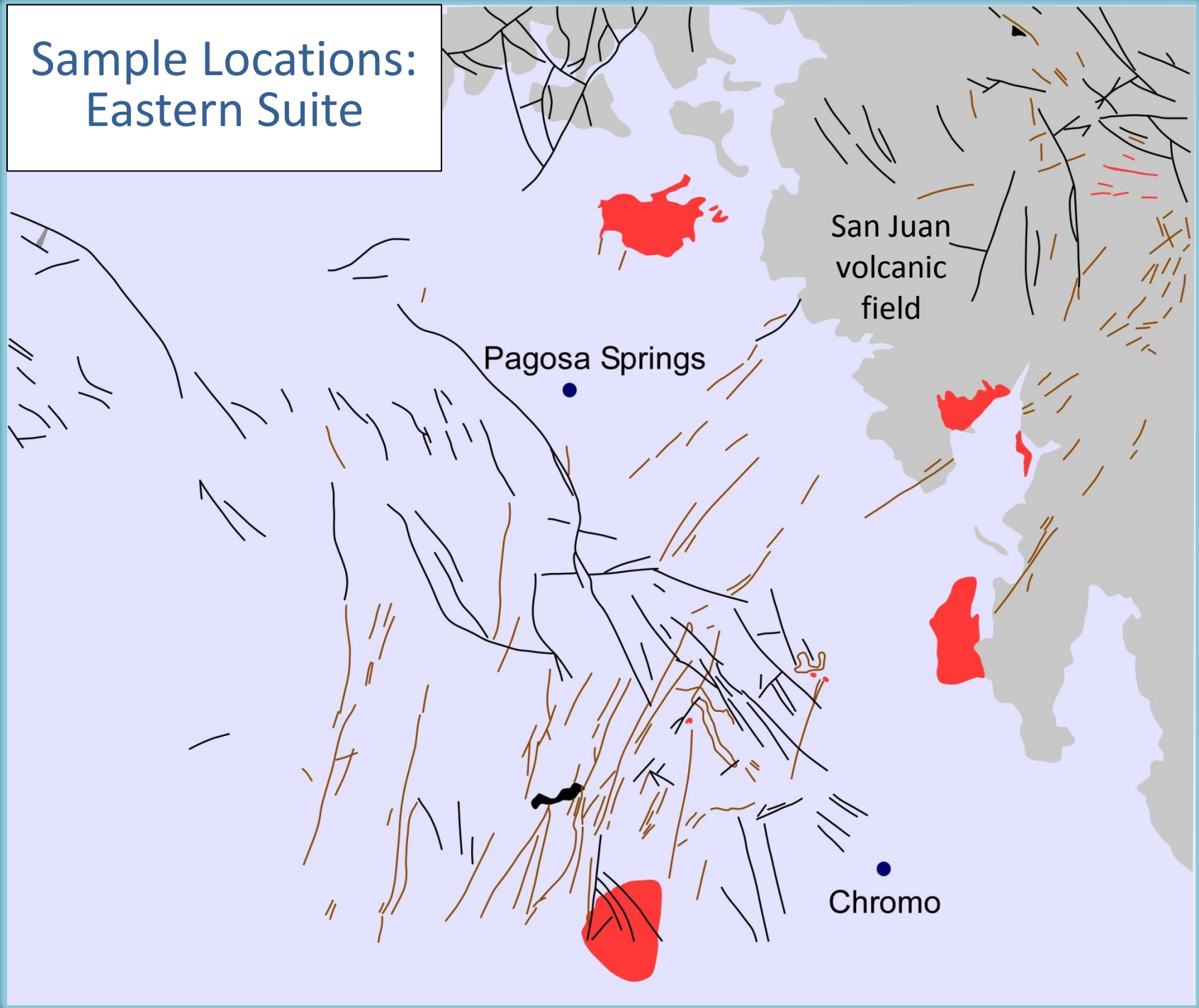


Modified from Cunningham et al., (1994)

Sample Locations: Western Suite



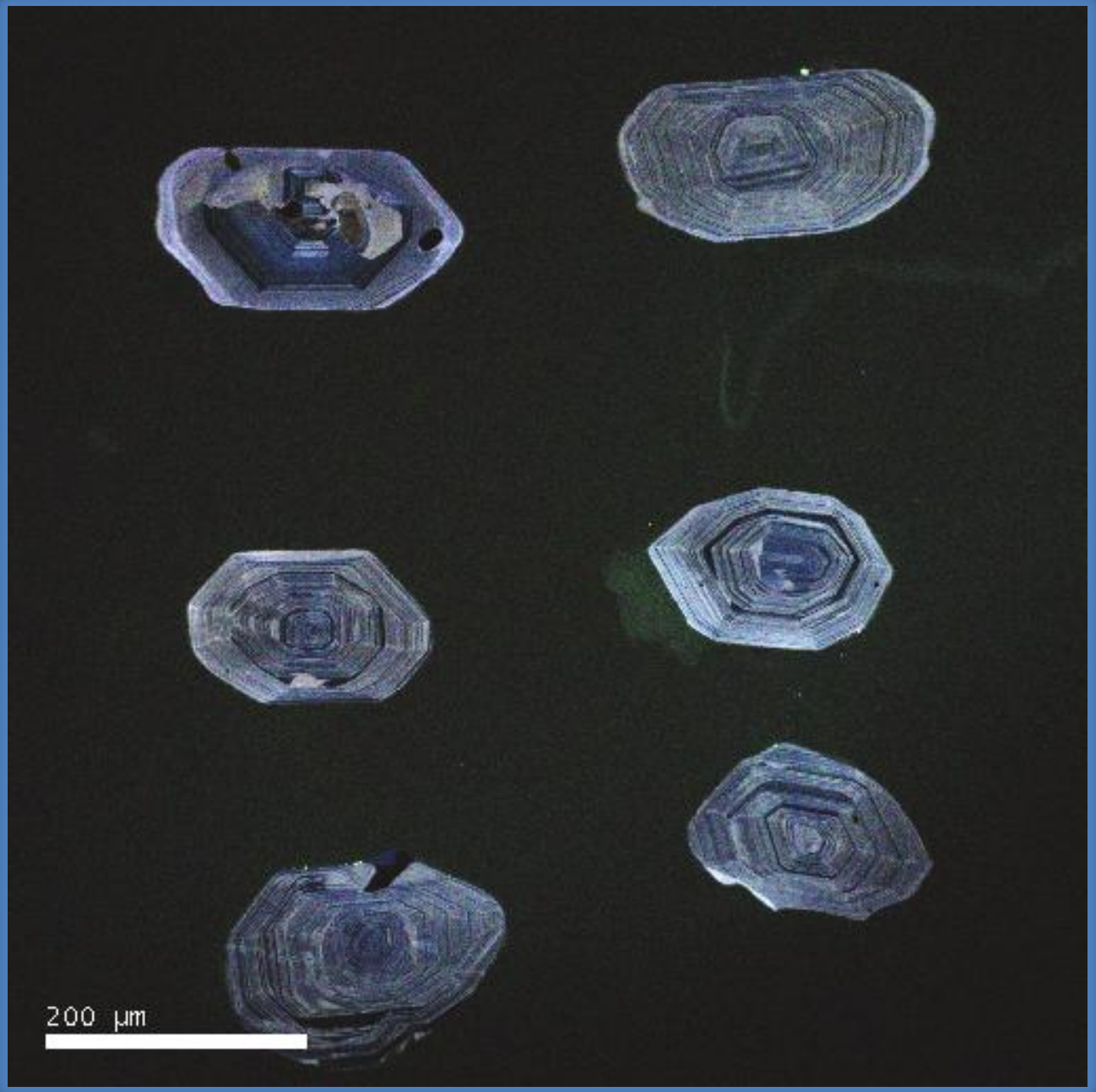
Sample Locations: Eastern Suite



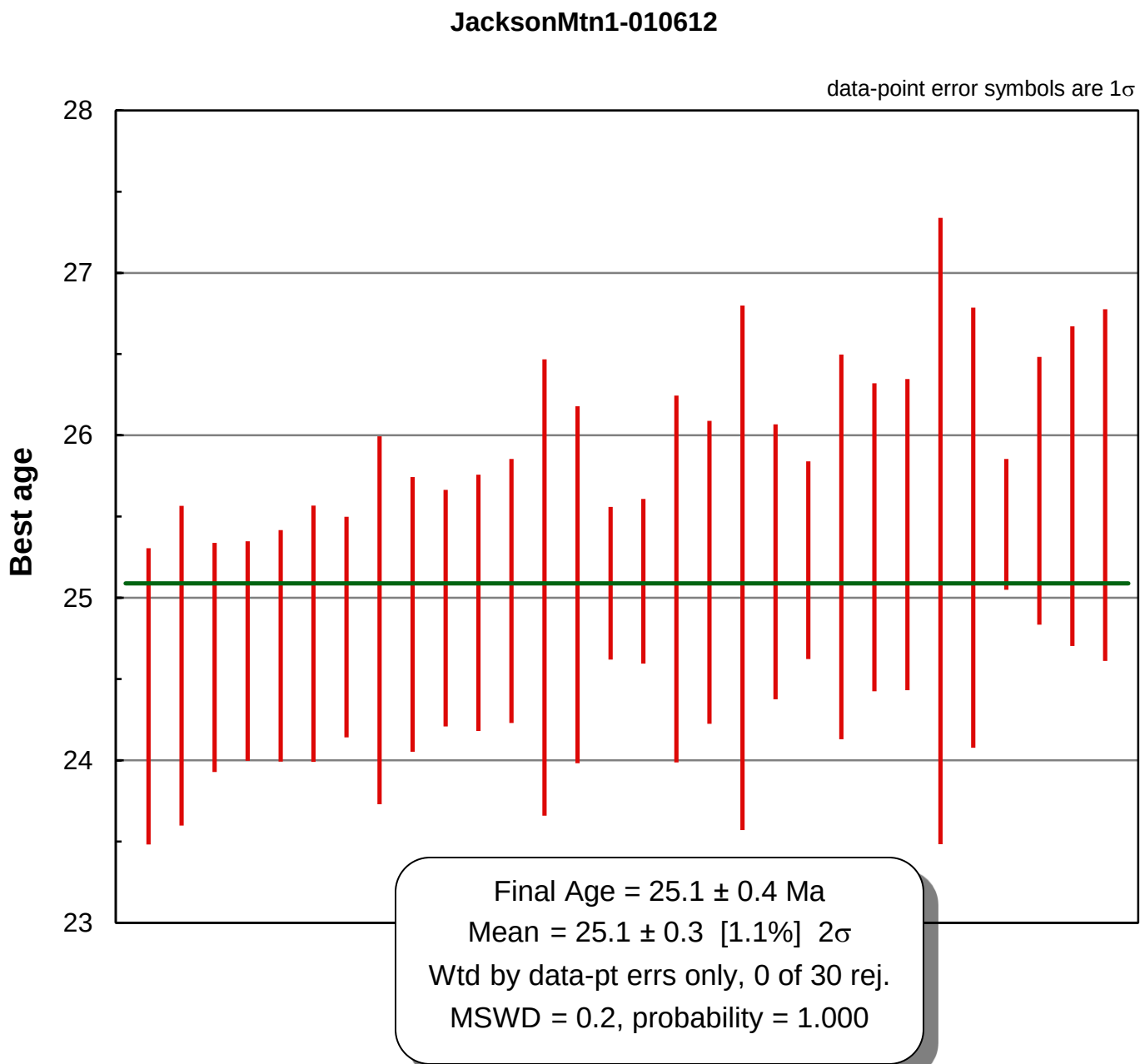
Methods

- Samples crushed and zircons separated
- HR MC LA-ICPMS @ University of Arizona
- 20 to 35 zircons per sample
- Data reduced and plotted with ISOPLOT

Jackson Mountain Zircons

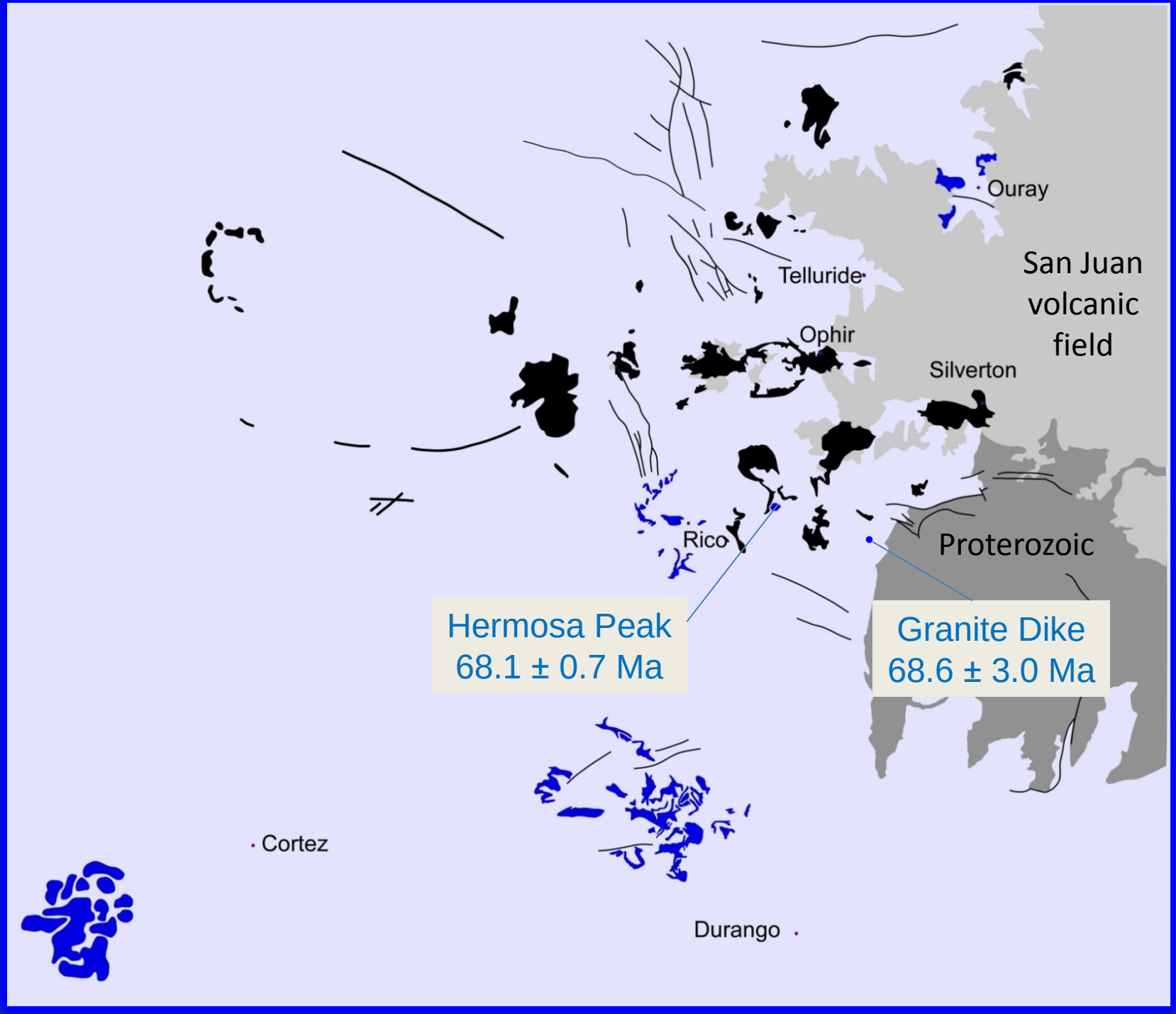


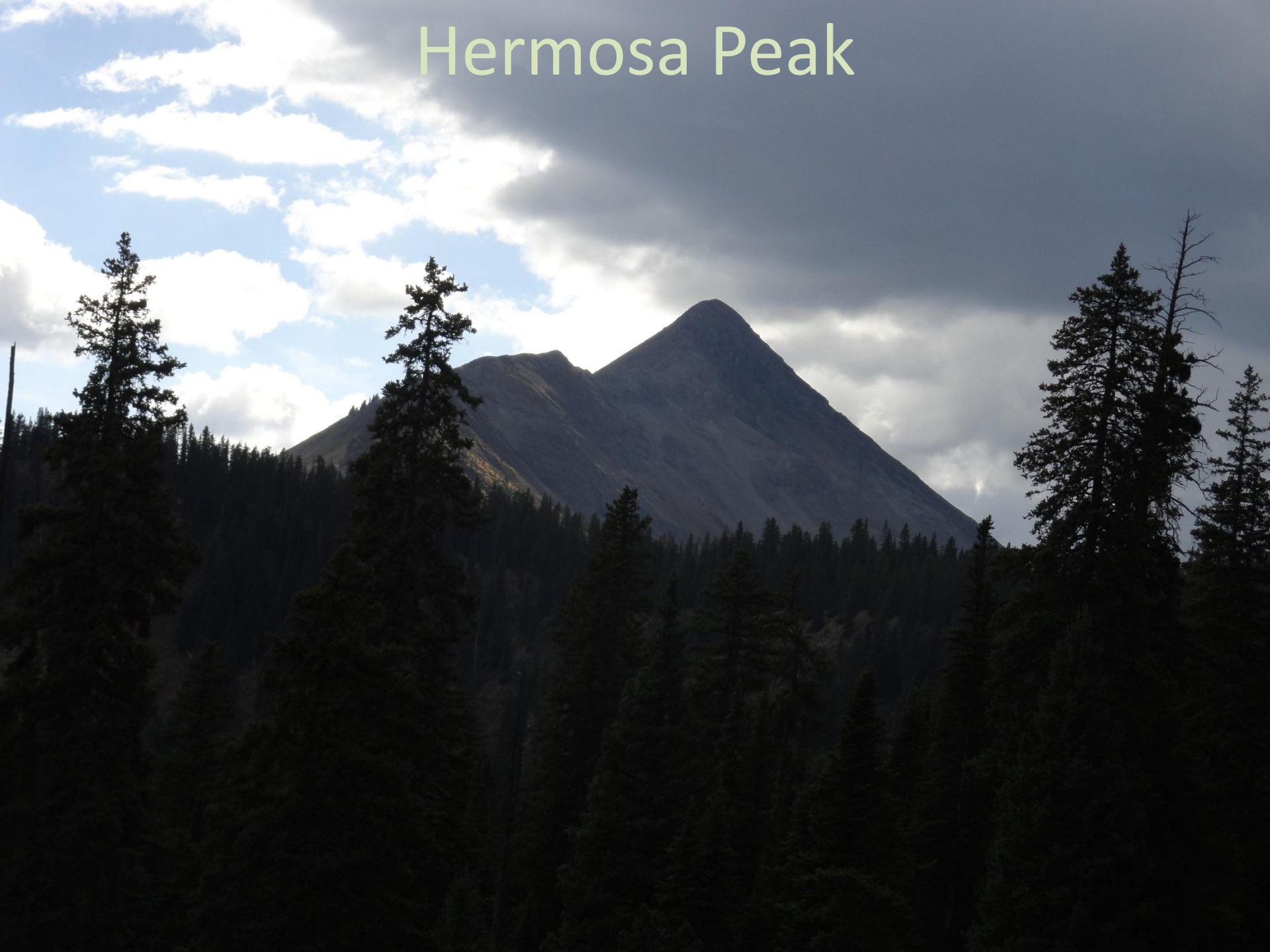
Jackson Mountain Zircon Data



New Zircon Ages: 75-65 Ma Plutons

Location	Age	MSWD	Probability
Hermosa Peak	**68.1 ± 0.7 Ma**	**0.19**	**1.0**
Granitic Dike @ Coal Bank Pass	**68.6 ± 3.0 Ma**	**0.105**	**0.96**
La Plata Mountains	75-65 Ma		
Ute Mountain	72-64 Ma		
Rico	65-60 Ma		
Ouray	54-50 Ma		

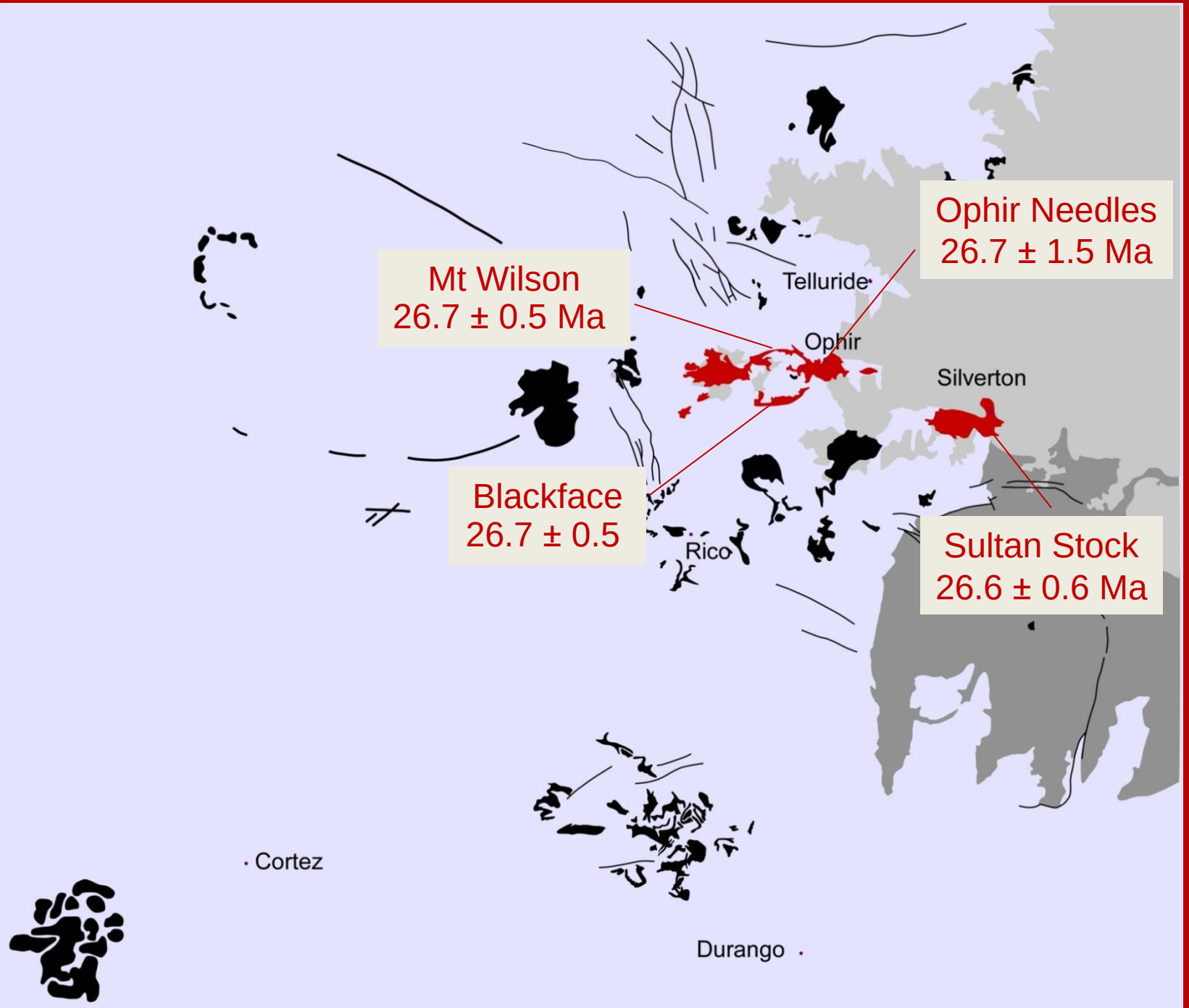

Ouray
San Juan volcanic field
Telluride
Ophir
Silverton
Rico
Proterozoic
Hermosa Peak
68.1 ± 0.7 Ma
Granite Dike
68.6 ± 3.0 Ma
Cortez
Durango


Hermosa Peak

Sill @ Coal Bank Pass

New Zircon Ages: 30-25 Ma Plutons in Western Suite

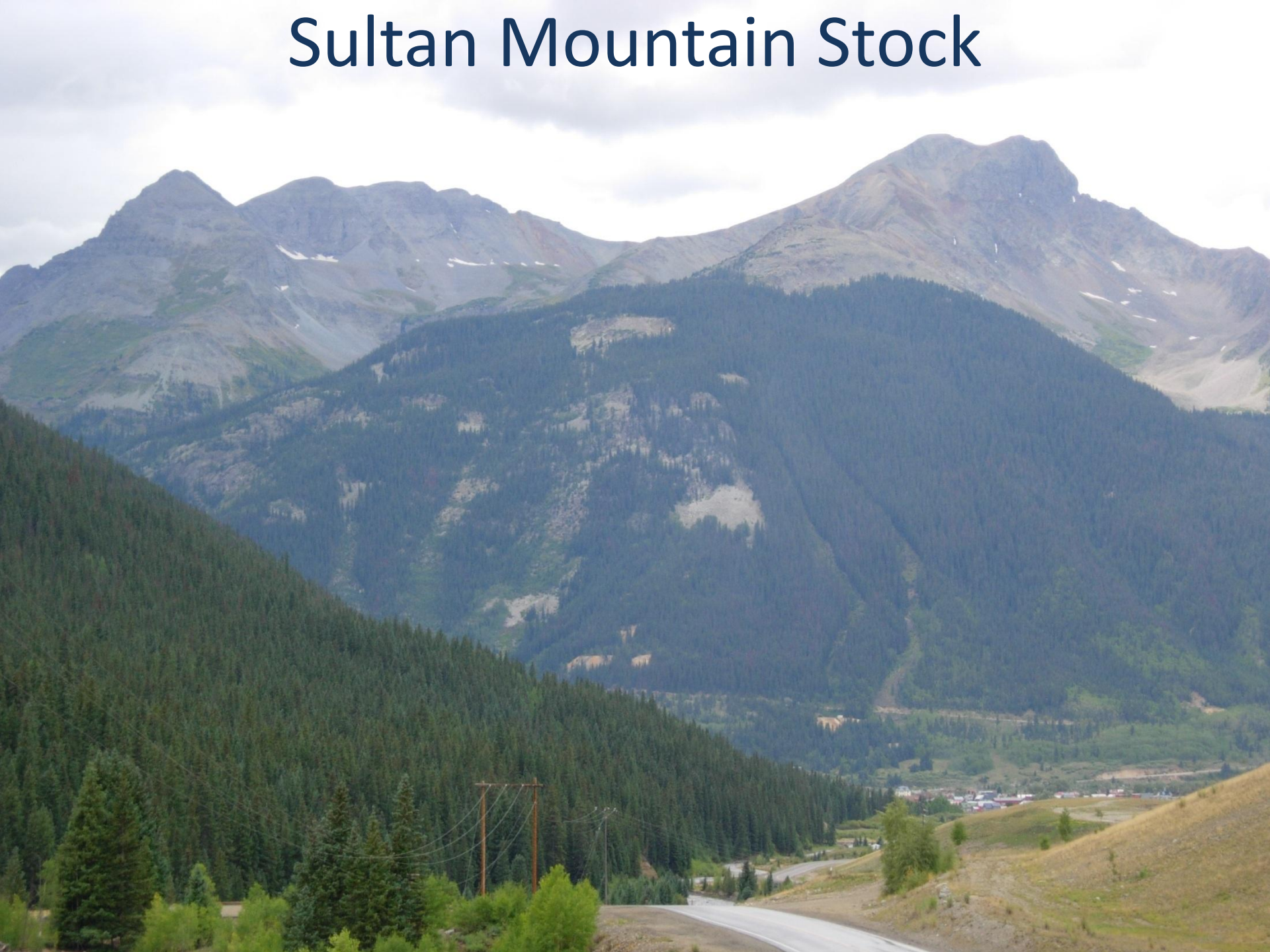
Location	Age	MSWD	Probability
Ophir Needles	26.7 ± 1.5 Ma	0.23	0.994
Blackface	26.0 ± 0.8 Ma	0.2	1.0
Eastern Mount Wilson Stock	26.7 ± 0.5 Ma	0.077	1.0
Sultan Stock	26.6 ± 0.6 Ma	0.1	1.0


Ophir Needles
26.7 ± 1.5 Ma
Mt Wilson
26.7 ± 0.5 Ma
Telluride
Ophir
Silverton
Blackface
26.7 ± 0.5
Rico
Sultan Stock
26.6 ± 0.6 Ma
Cortez
Durango

Blackface-Mount Wilson Complex

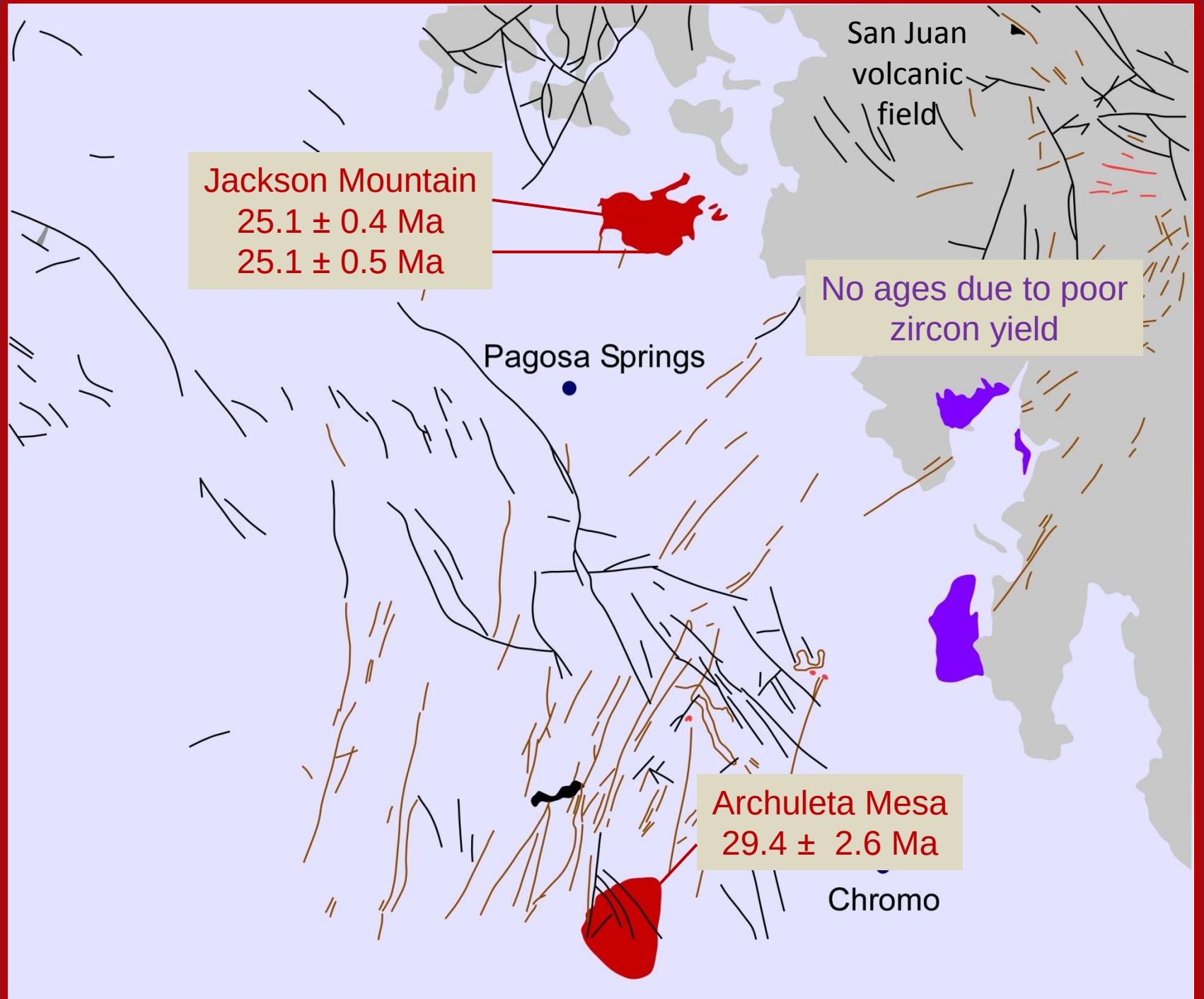
Ophir Needles

Sultan Mountain Stock



New Zircon Ages: 30-25 Ma Plutons in Eastern Suite

Location	Age	MSWD	Probability
*Archuleta Mesa	29.4 ± 2.6 Ma	0.47	0.49
Jackson Mountain	25.1 ± 0.5 Ma	0.4	1.0
Jackson Mountain	25.1 ± 0.4 Ma	0.2	1.0

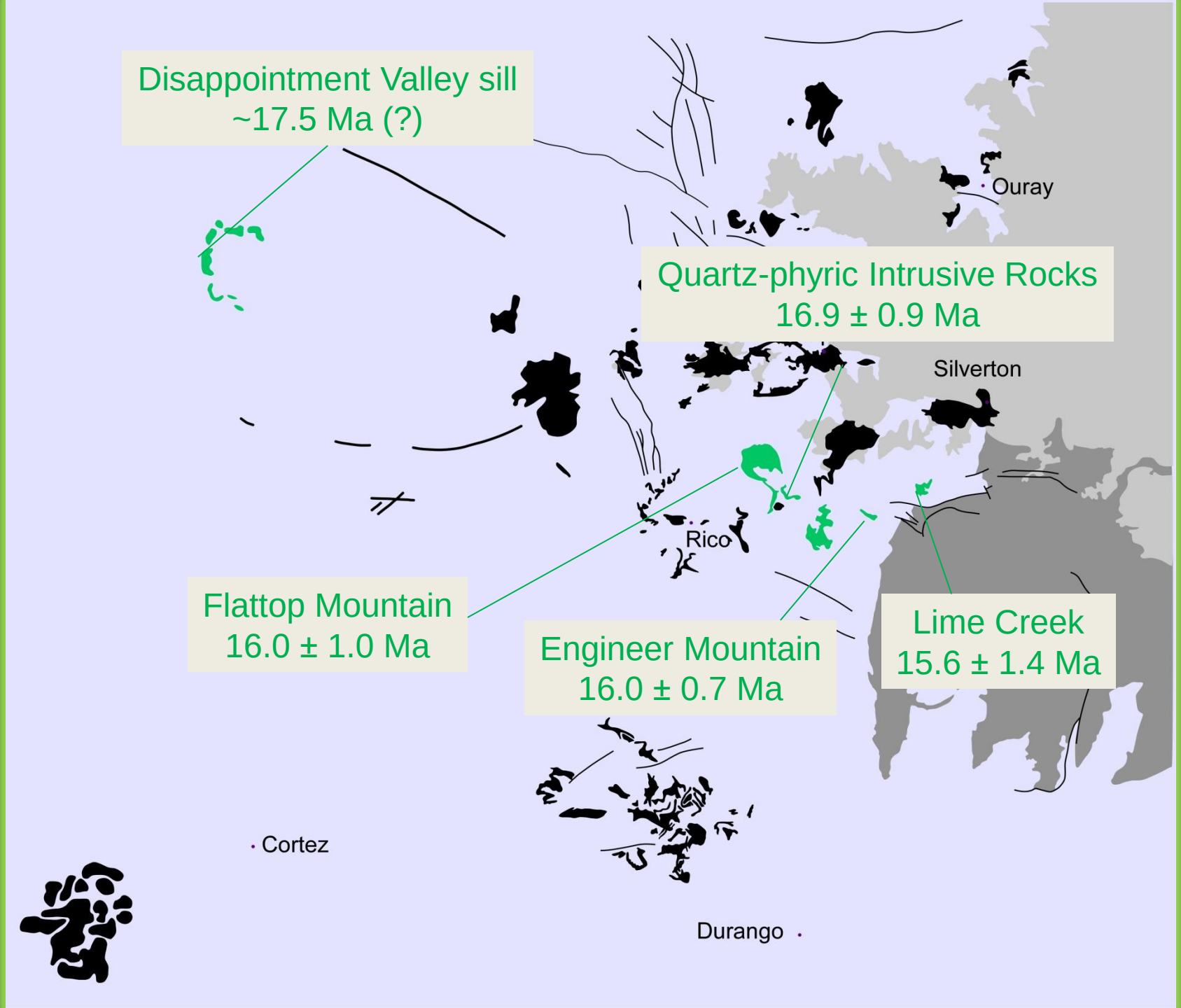

San Juan
volcanic
field
Jackson Mountain
25.1 ± 0.4 Ma
25.1 ± 0.5 Ma
No ages due to poor
zircon yield
Pagosa Springs
Archuleta Mesa
29.4 ± 2.6 Ma
Chromo

Square Top Mountain

Gabbroic to Dioritic Sills

New Zircon Ages: 17-15 Ma Plutons in Western Suite

Location	Age	MSWD	Probability
Flattop Mountain	16.0 ± 1.0 Ma	0.064	1.0
Quartz-Phyric Intrusive Rocks at Hermosa Peak	16.9 ± 0.9 Ma	0.40	1.0
Engineer Mountain	16.0 ± 0.7 Ma	0.30	1.0
Lime Creek stock	15.6 ± 1.4 Ma	0.10	1.0
*Disappointment Valley sill	~17.5 Ma (?)		Poorly Constrained

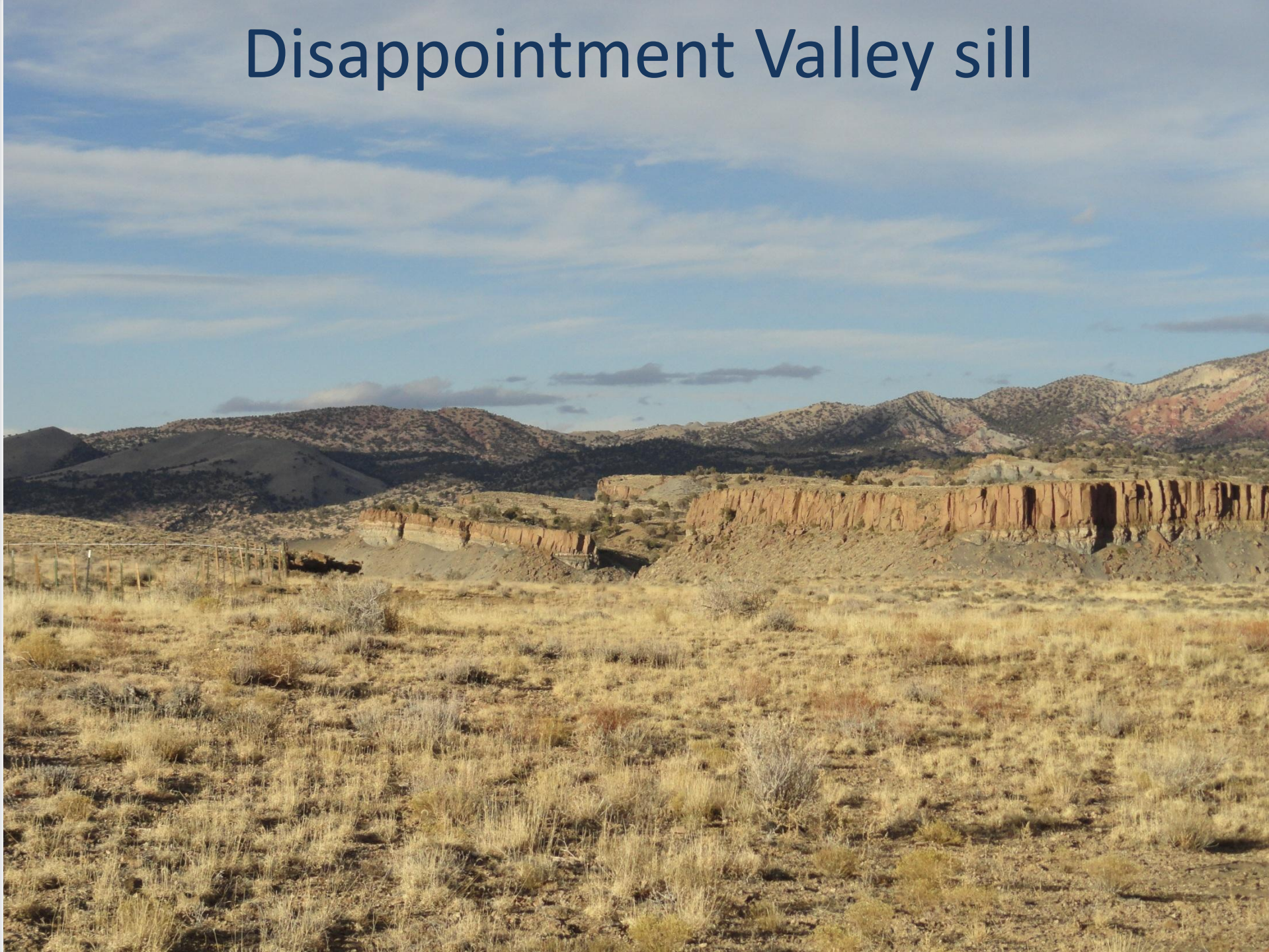

Disappointment Valley sill
~17.5 Ma (?)
Ouray
Quartz-phyric Intrusive Rocks
16.9 ± 0.9 Ma
Silverton
Rico
Flattop Mountain
16.0 ± 1.0 Ma
Engineer Mountain
16.0 ± 0.7 Ma
Lime Creek
15.6 ± 1.4 Ma
Cortez
Durango

Flattop Mountain

Engineer Mountain-Graysill

Lime Creek “cactolith”

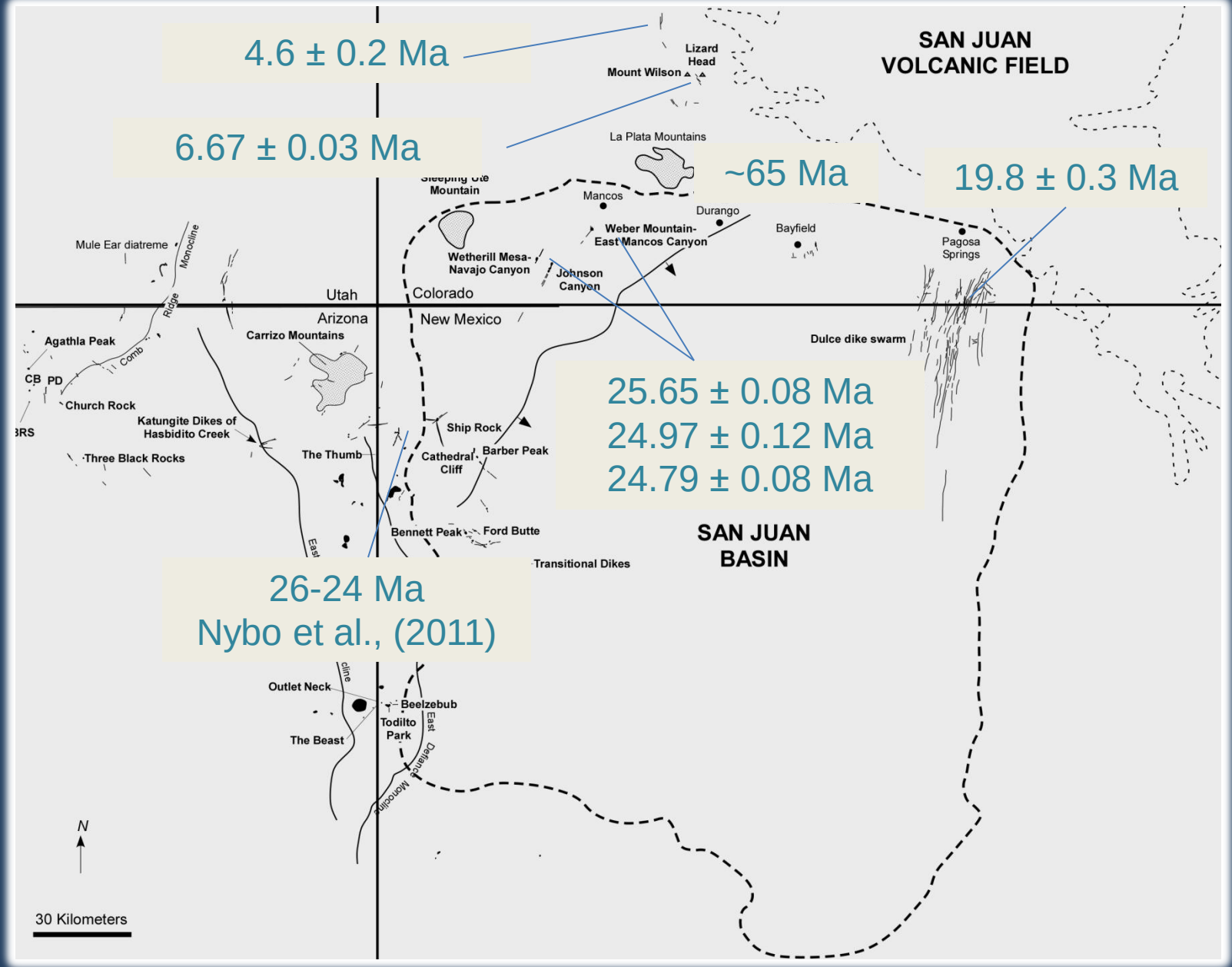
Disappointment Valley sill

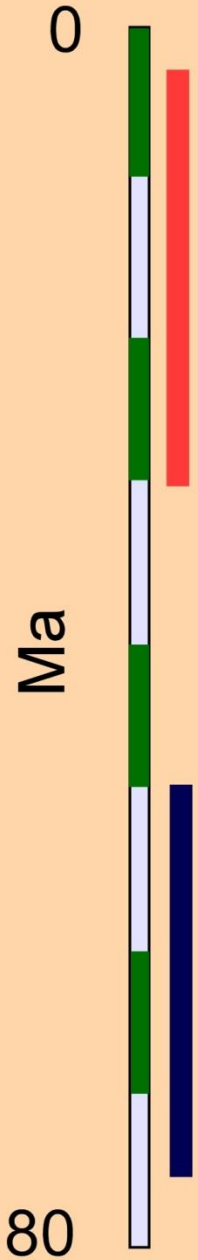


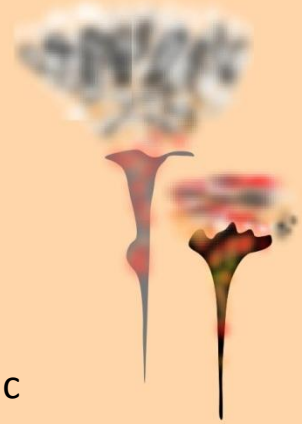
Timing of Mantle Magmatism

Ar-Ar ages on alkaline mafic dikes in region in the past 5 years indicate long-lived mantle magmatism at ~65 Ma and from 25 to 5 Ma (Gonzales et al., 2010 + unpublished data; Nybo et al., 2011; Carrara, 2012).

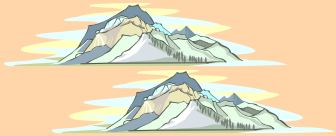
Ages of Cenozoic Diatremes & Mafic Dikes







Fragments of porphyritic
intrusive rock
In Telluride Conglomerate

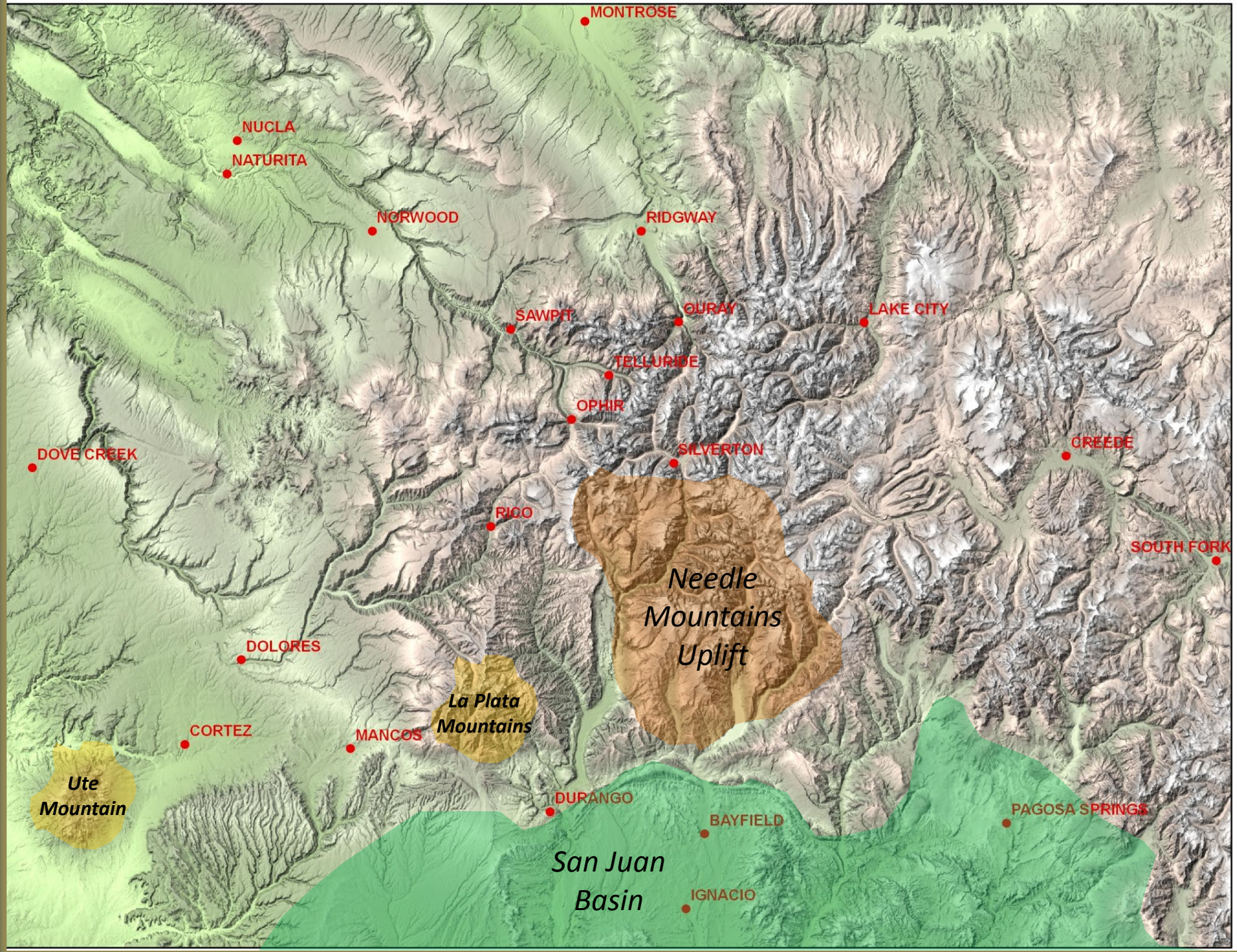


Key Points

- A more continuous record of mantle-crustal magmatism in Western San Juan Mountains than previously documented.

- Plutons have caused local to regional crustal inflation and thousands of feet of uplift (e.g., disruption of ~29 Ma Telluride Conglomerate); influenced landscape development.

- 26 Ma and 17 to 10 Ma intrusive rocks are mineralized and coincide with major period of epithermal mineralization in the area.


MONTROSE
NUCLA
NATURITA
NORWOOD
RIDGWAY
SAWPIT
OURAY
LAKE CITY
TELLURIDE
OPHIR
SILVERTON
CREEDE
DOVE CREEK
RICO
SOUTH FORK
Needle Mountains Uplift
DOLORES
La Plata Mountains
CORTEZ
MANCOS
Ute Mountain
DURANGO
BAYFIELD
PAGOSA SPRINGS
San Juan Basin
IGNACIO

Addendum

- Previous geochemical and isotope data indicate that lithospheric mantle was a major reservoir from 80 to 5 Ma producing alkaline to subalkaline mafic to intermediate magmas.

- Inherited Proterozoic zircons in all intrusive rocks analyzed support the reactivation of old crust during generation of melts.