HYDROGEOLOGY OF SPRINGS IN THE NORTHERN GREAT BASIN IN OREGON

Hank Johnson

U.S. Geological Survey

Oregon Water Science Center

Springs Ecosystem Science: 2018 Symposium

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U.S. Department of the Interior
U.S. Geological Survey

“Can you age-date spring water?”

Linus Meyer, BLM (retired)

Underlying questions:

- Sage grouse habitat preservation and restoration
- Impacts of drought and climate change
- Sustainability for cattle and wildlife
- Prioritize funding for infrastructure

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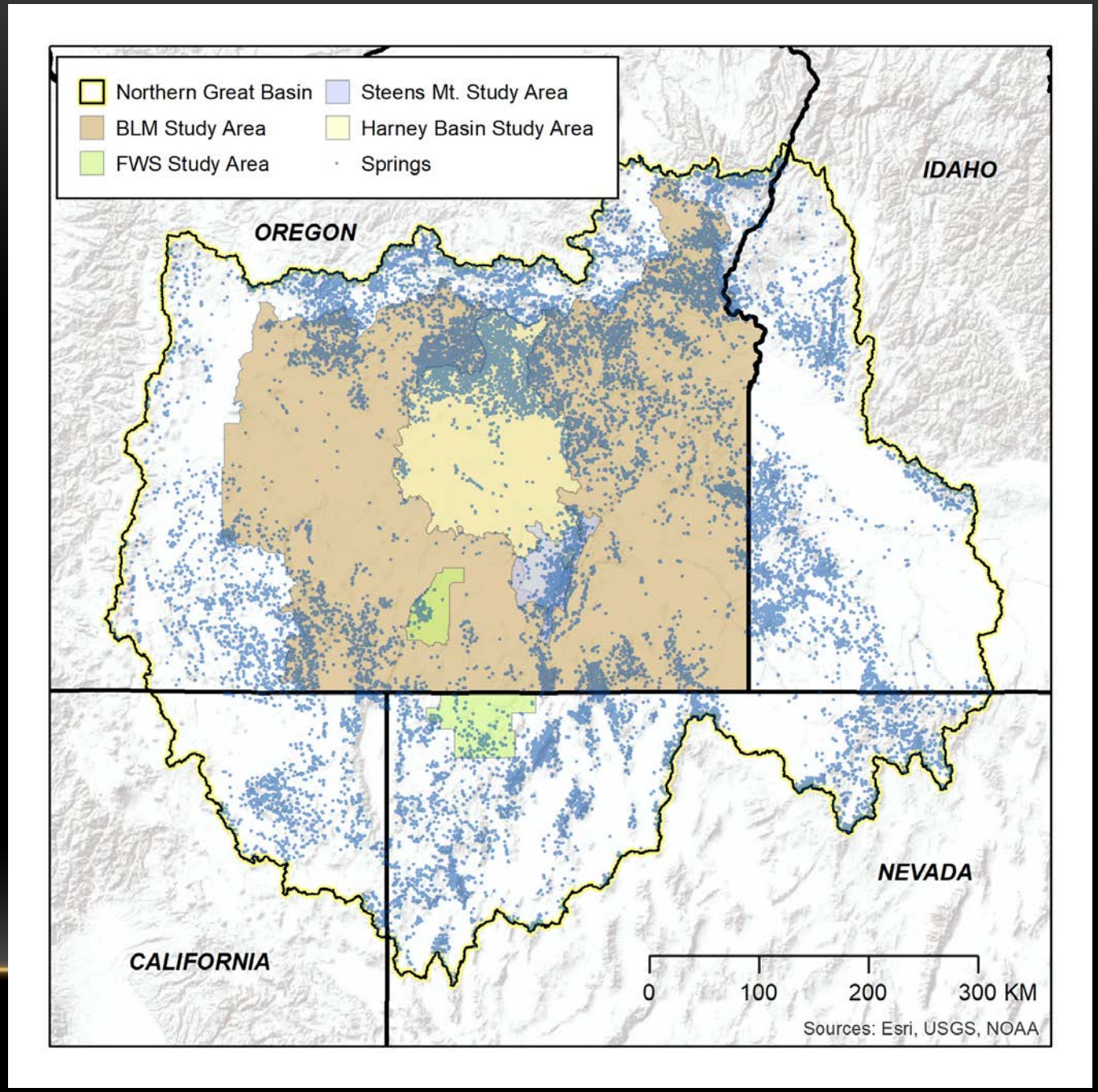
Four studies with overlapping interests in springs in the Northern Great Basin in Oregon:

- BLM
- Fish and Wildlife Service (FWS) – extension of BLM project onto the Hart-Sheldon Refuge Complex
- Harney Basin groundwater availability study
- Steens Mountain spring variability (recently completed)



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- *Spring points from National Hydrographic Dataset, https://nhd.usgs.gov/*

PROJECT GOAL

Understand the fundamental processes controlling spring occurrence and variability in discharge

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HYPOTHESIS

Spring location, discharge, and discharge variability are principally determined by:

- Proximity to precipitation sources
- Volume and type of precipitation
- Geology (lithology and structure)
- Topographic location

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APPROACH

Stratified sampling based on factors driving our hypothesis

Field inventory

- Geologic and topographic setting
- Physical characteristics (size, shape, discharge)
- Water chemistry (T, SC, pH)
- Stable isotopes
- Age tracers: tritium, carbon-14, gas-based methods when possible

Temporal variability at selected sites

Geospatial analysis

Statistical analysis

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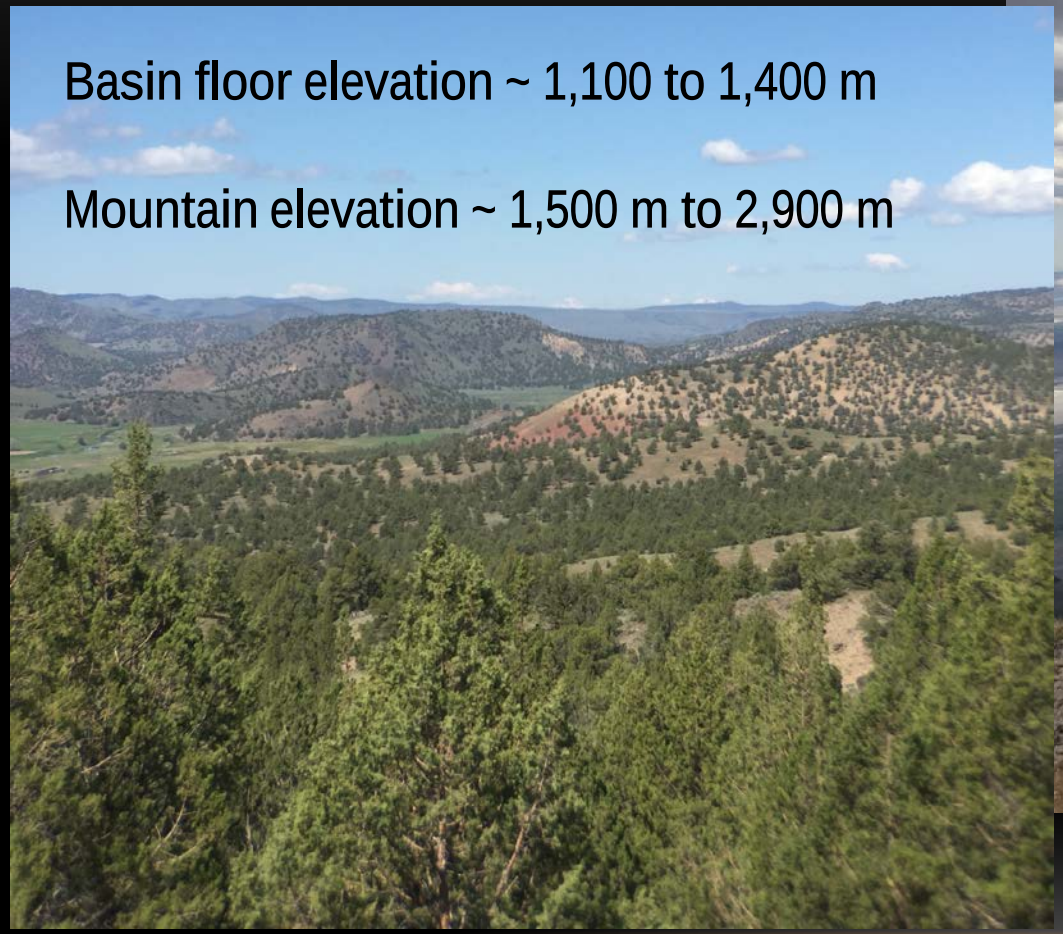
STUDY AREA INTRODUCTION

High desert / Basin and Range



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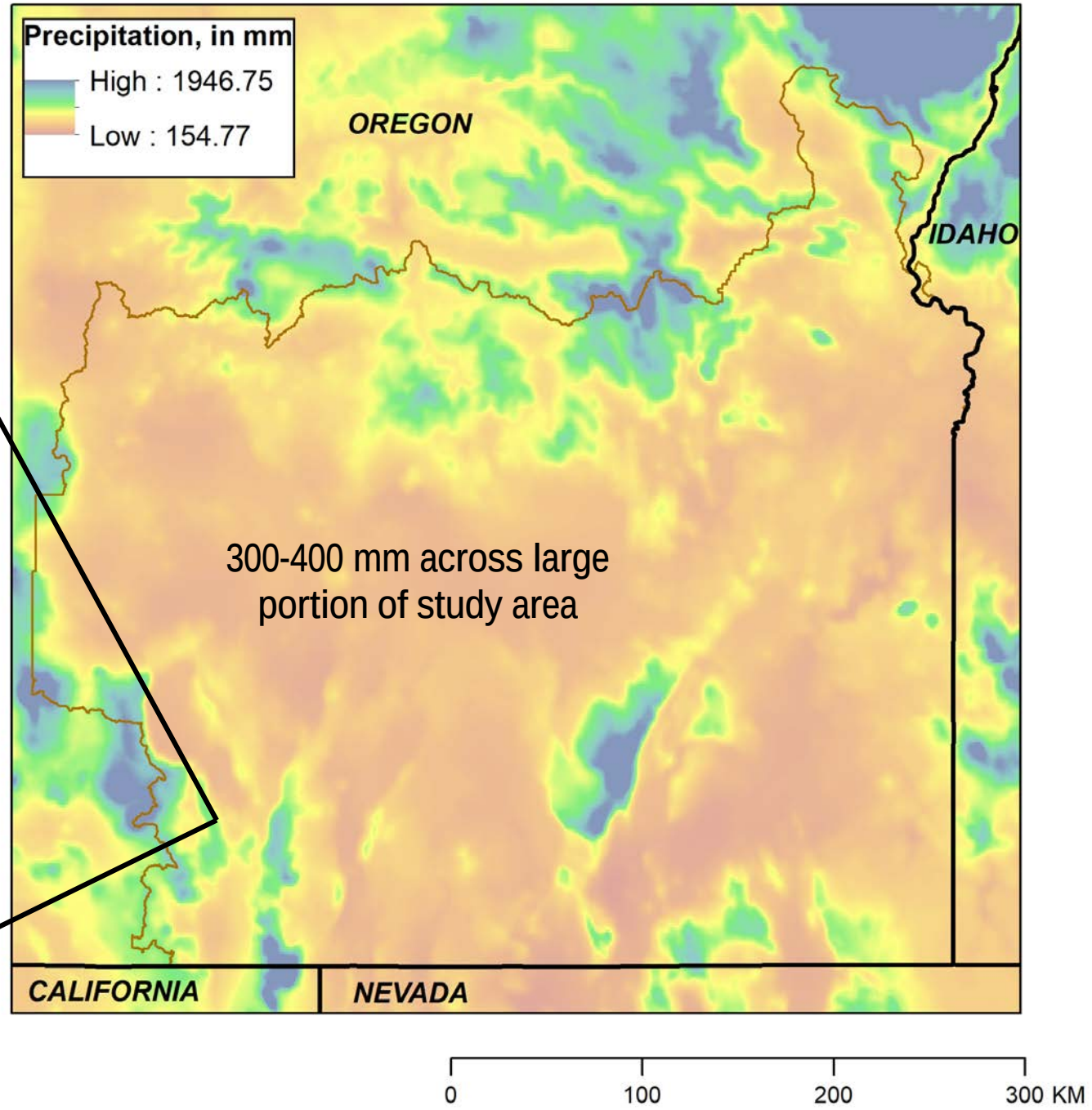
STUDY AREA INTRODUCTION

Precipitation strongly correlated with elevation

Primarily snow

Photo by Hank Johnson, U.S. Geological Survey



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- *1981-2010 Mean annual precipitation from PRISM Climate Group, http://www.prism.oregonstate.edu/*

STUDY AREA INTRODUCTION

Small amounts of water = large change in vegetation

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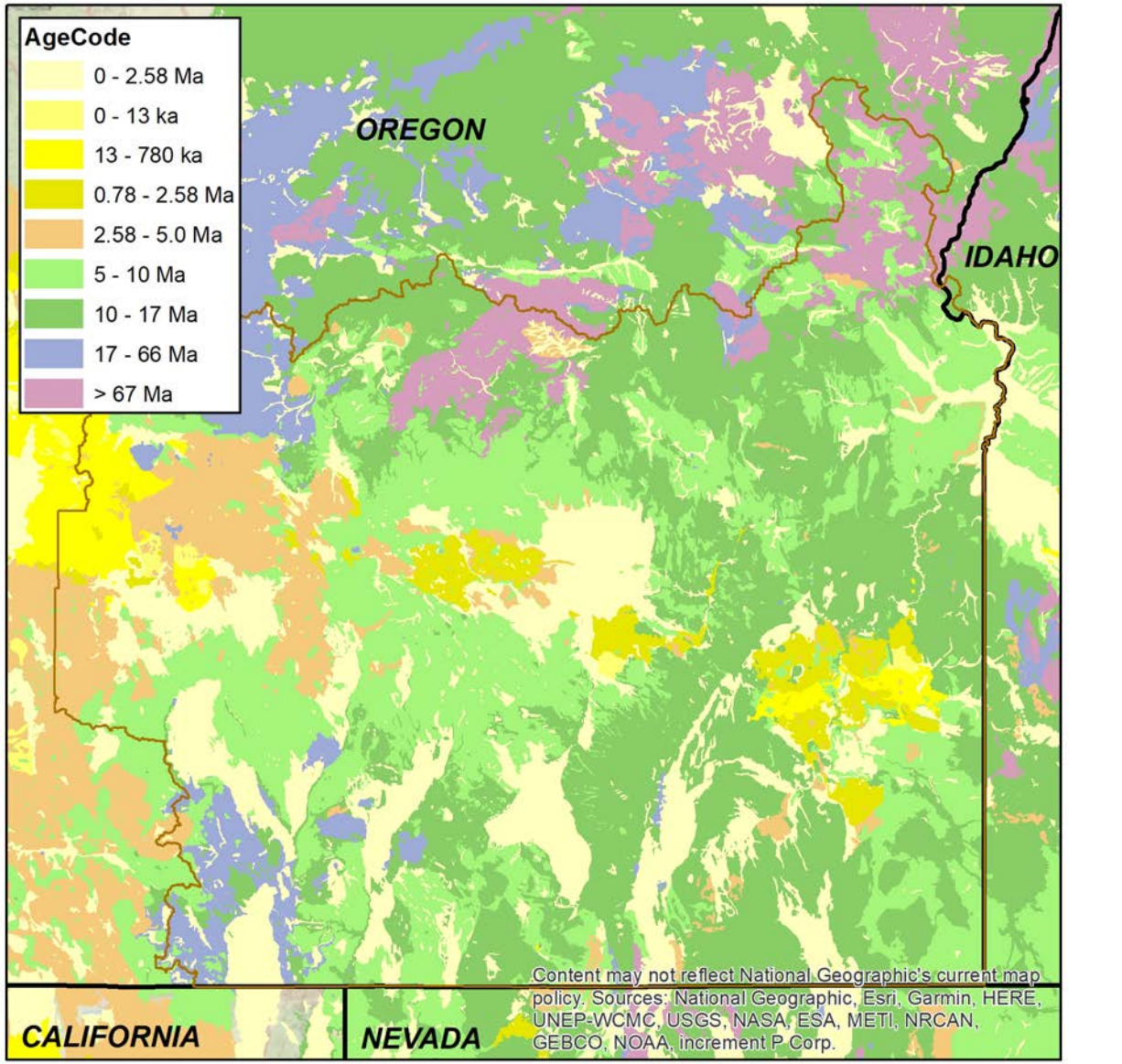
GEOLOGIC SETTING

Study area is dominated by 5 – 17 Ma volcanic rocks and volcaniclastic sediments (Miocene)

Late Miocene volcanic ash fall (tuff)

Photo by Hank Johnson, U.S. Geological Survey



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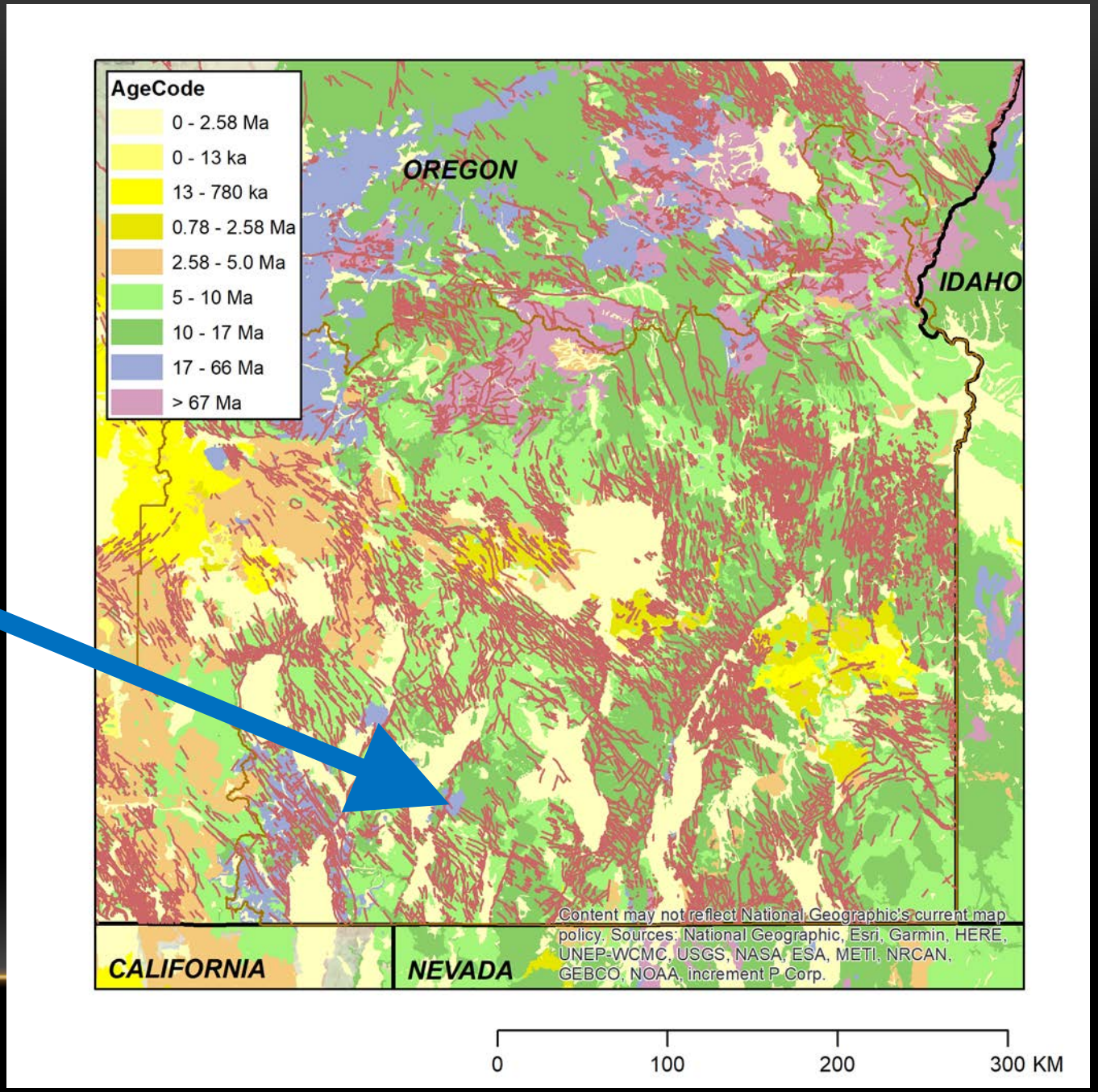
- *Geology from Sherrod and McKenzie, https://doi.org/10.3133/ofr20181030*

GEOLOGIC SETTING

Region is dissected by faults



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- *Faults from Oregon Department of Geology and Mineral Industries, http://www.oregongeology.org/pubs/dds/p-OGDC-6.htm*

PRELIMINARY MUSINGS

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MAJOR SPRING CLASSES

Regional Springs

- Large volume (for SE Oregon)
- Stable chemistry
- Long flow path
- Old water
- Often thermal

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Photo by Hank Johnson, U.S. Geological Survey

MAJOR SPRING CLASSES

Local Springs

- Small volume
- Often exhibit seasonality in
  - discharge
  - chemistry
- Short flow path
- May respond to differences in inter-annual precipitation
- Young water

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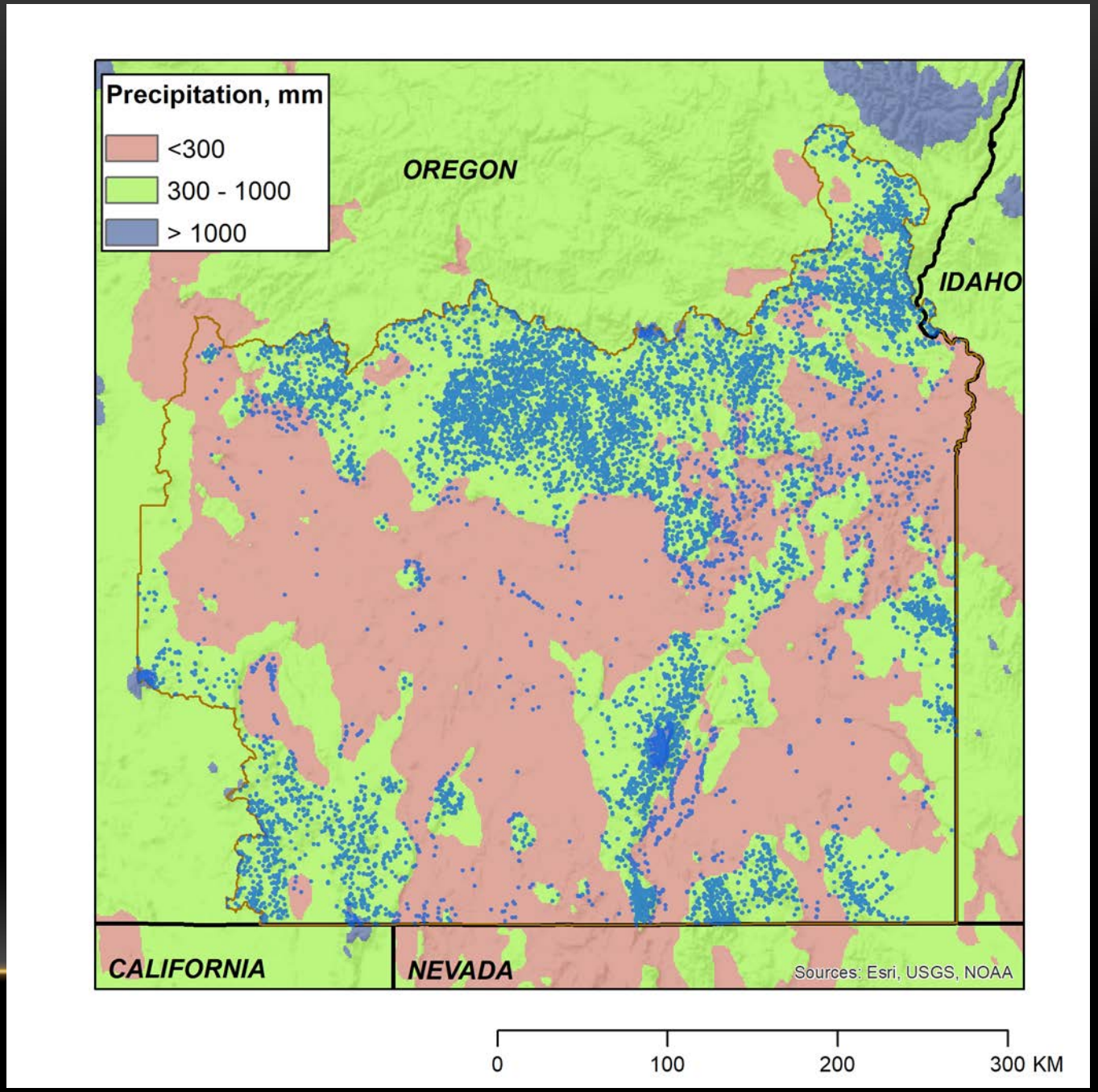
Photo by Hank Johnson, U.S. Geological Survey

PRECIPITATION IS HIGHLY CORRELATED WITH SPRING OCCURRENCE



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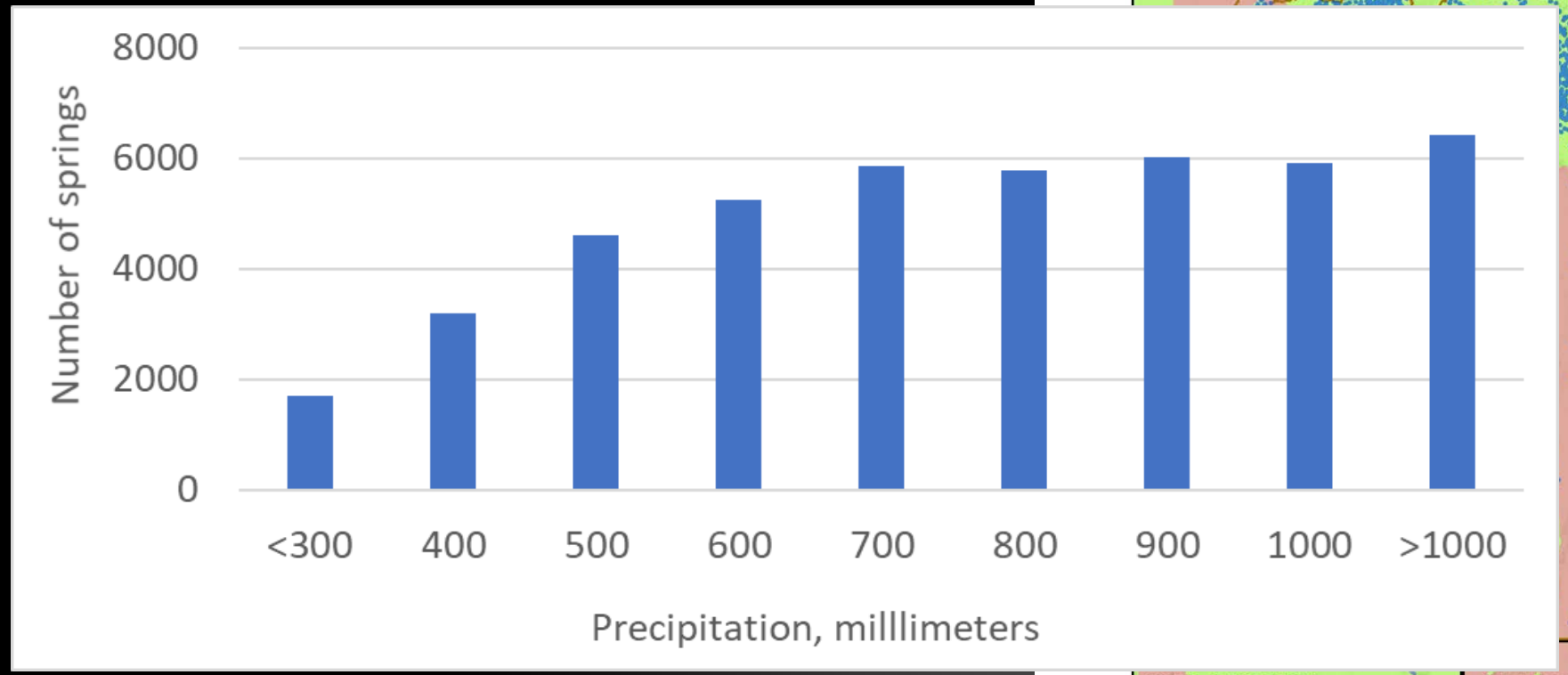

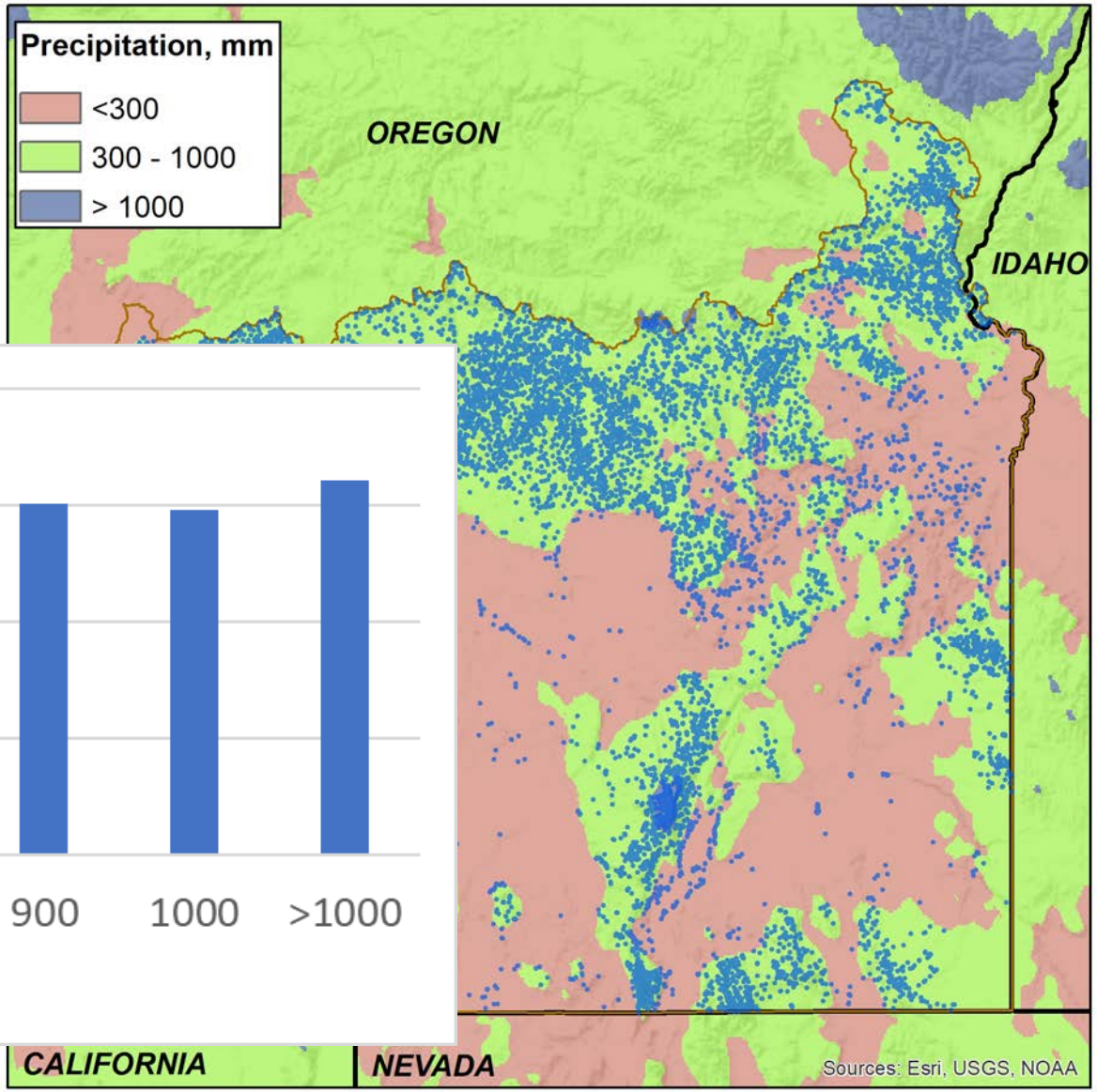

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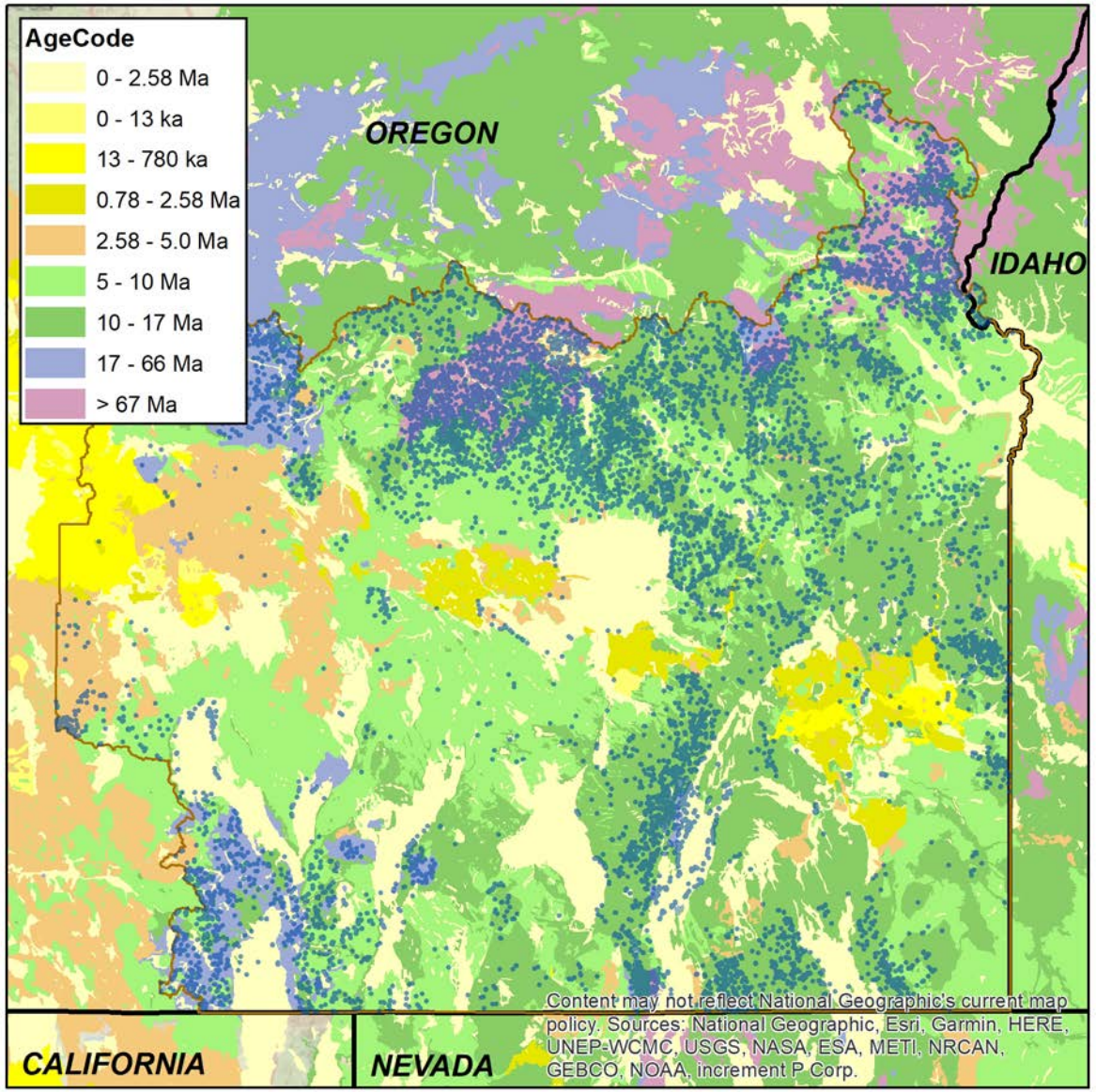
GEOLOGY & SPRINGS

Spring distribution does not strictly follow precipitation patterns



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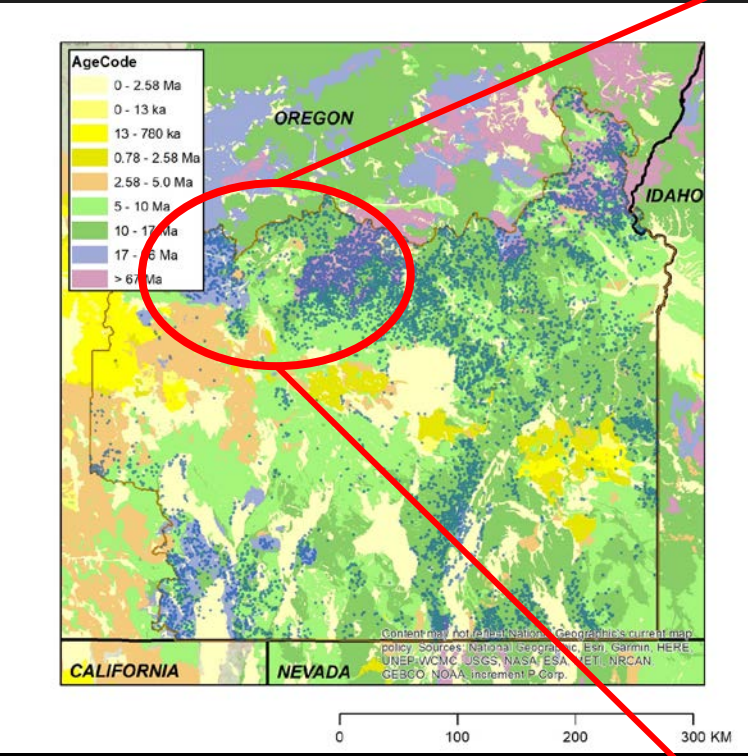
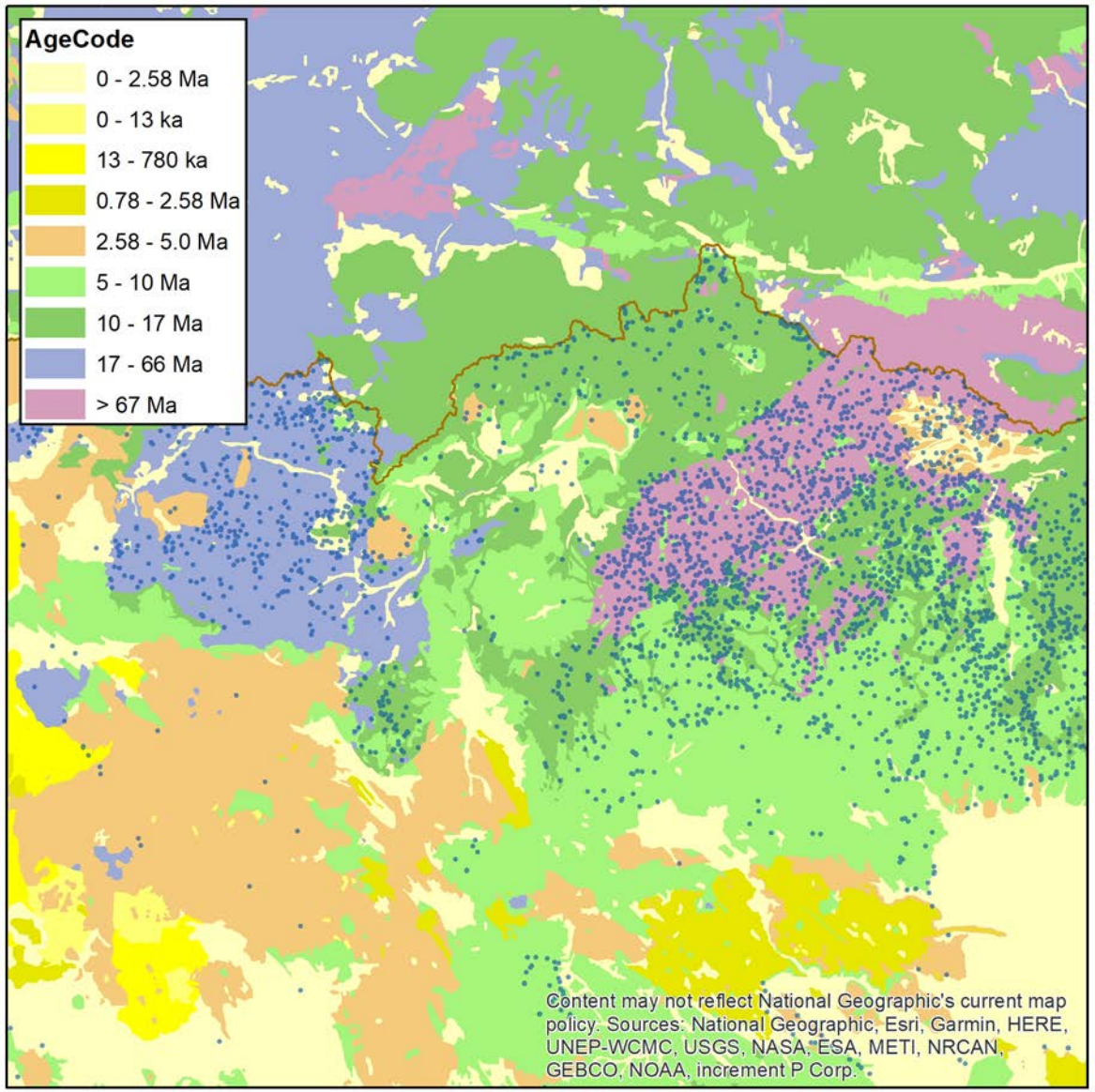


Permeability differences



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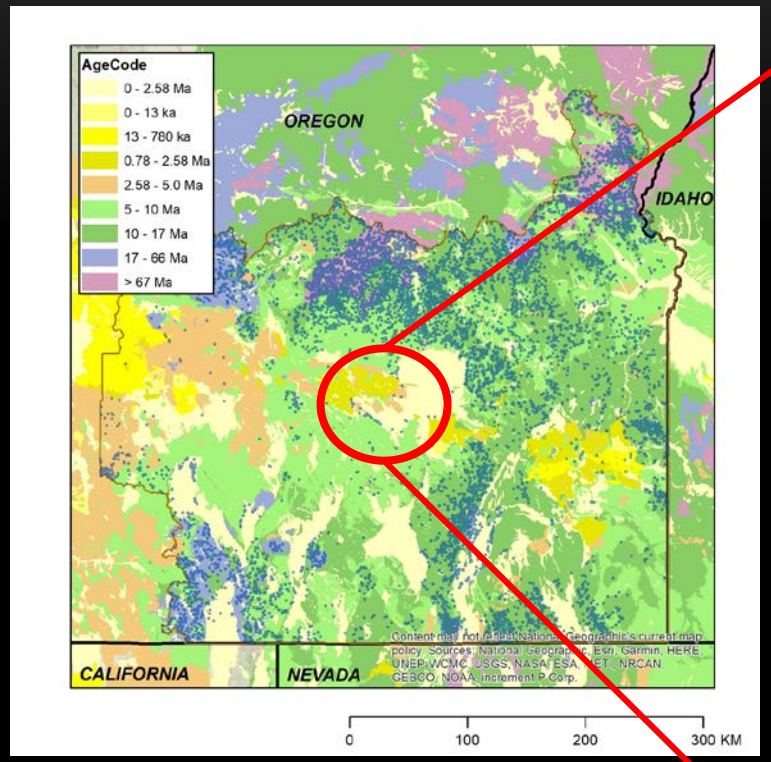
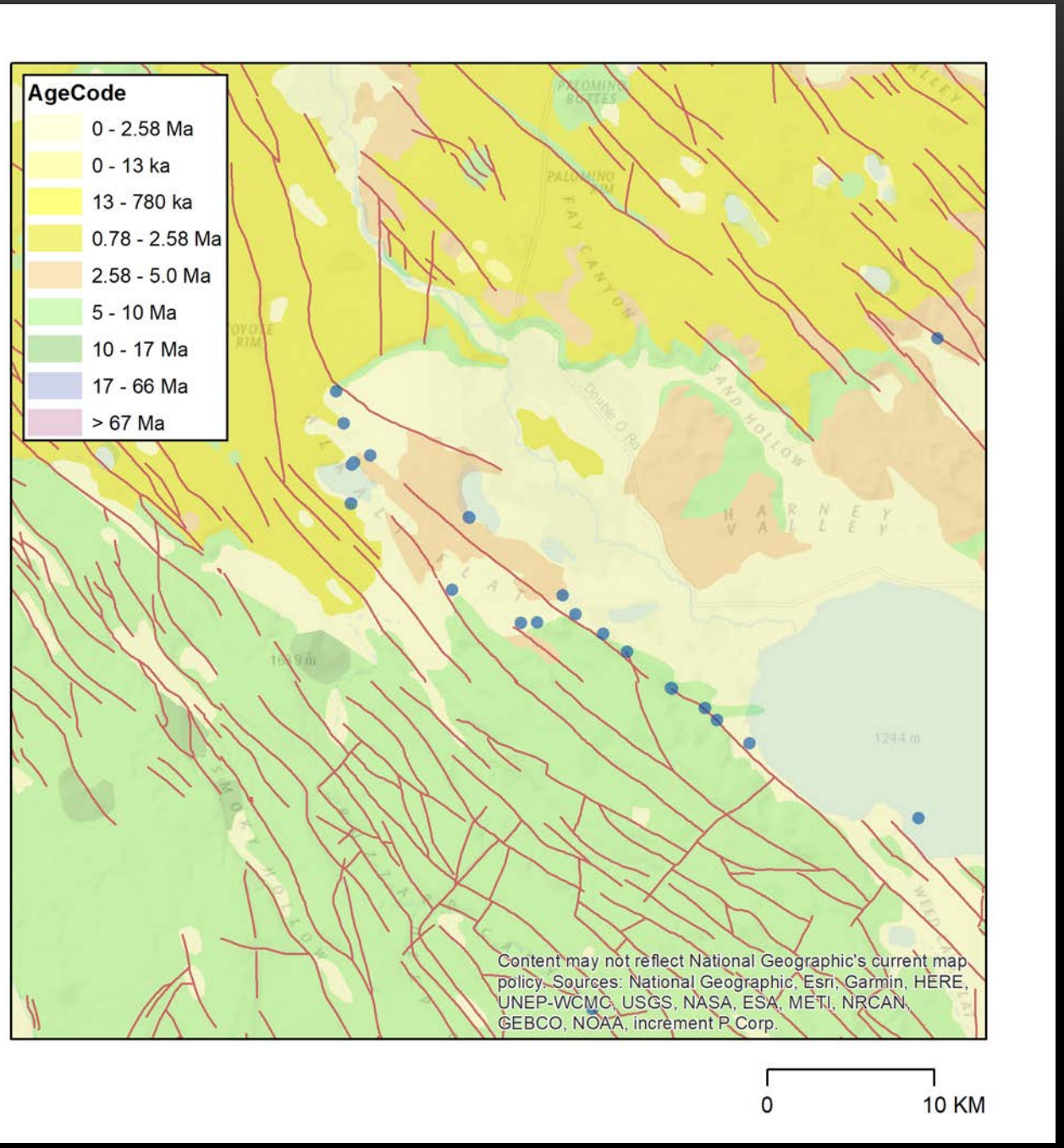
GEOLOGY & SPRINGS



Fault controlled



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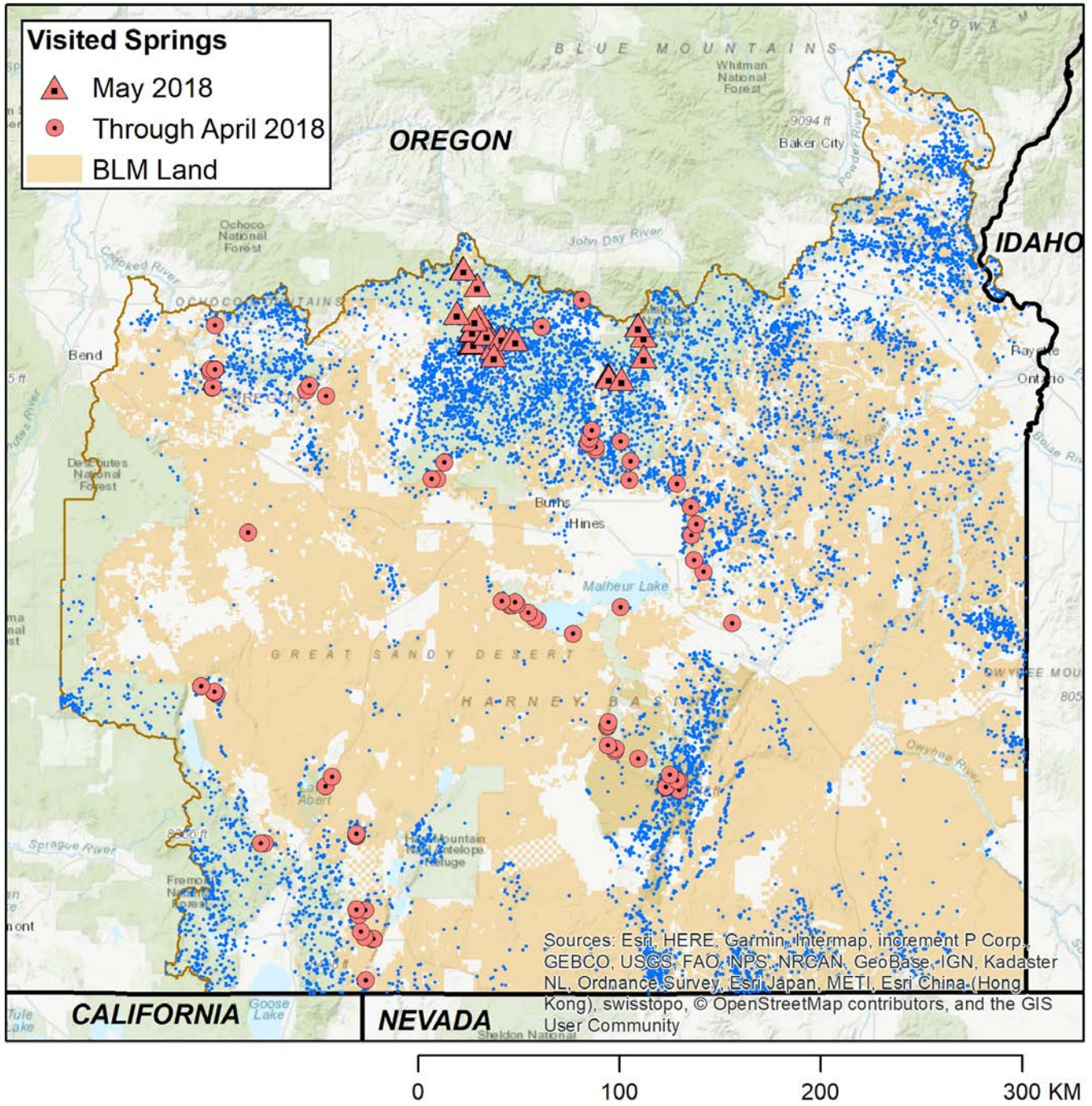
SAMPLE LOCATIONS



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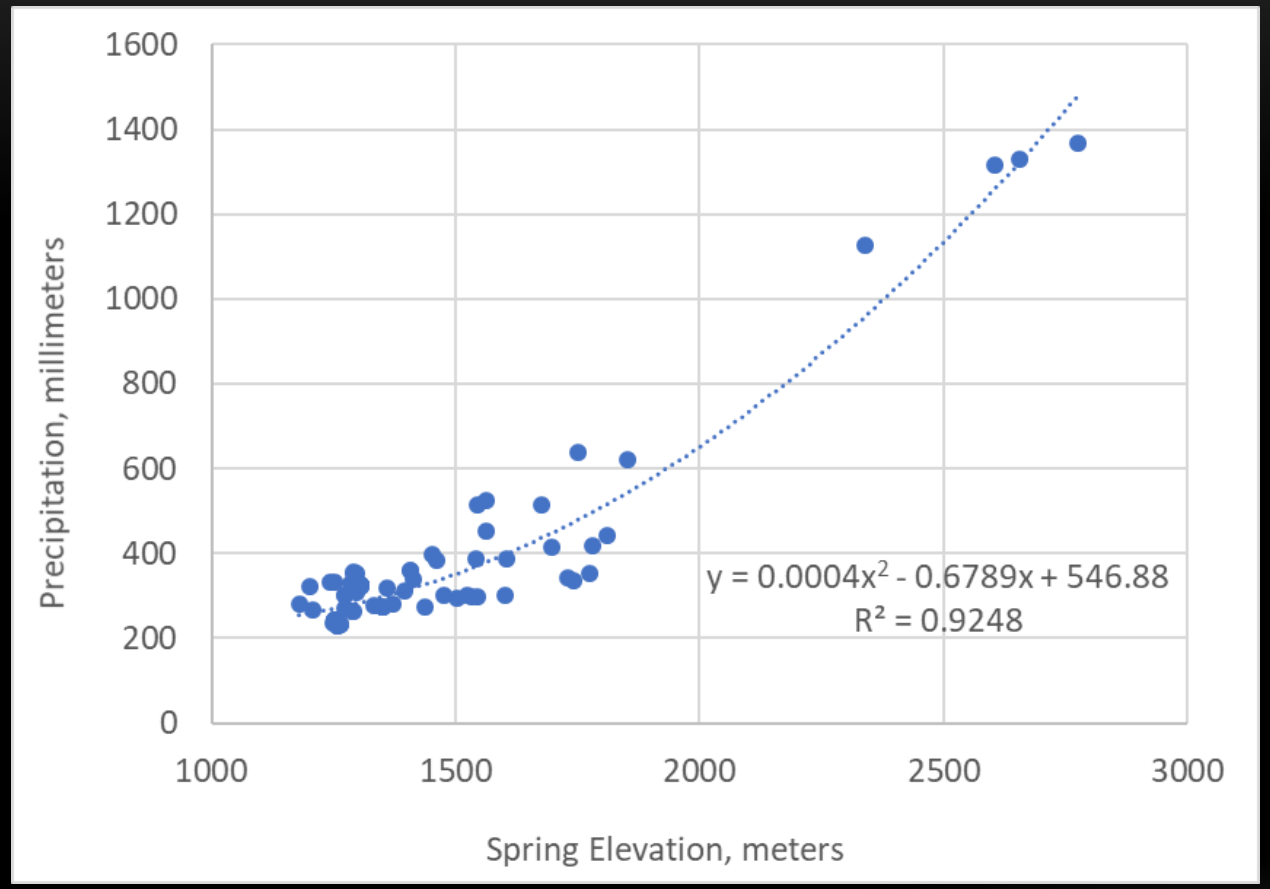
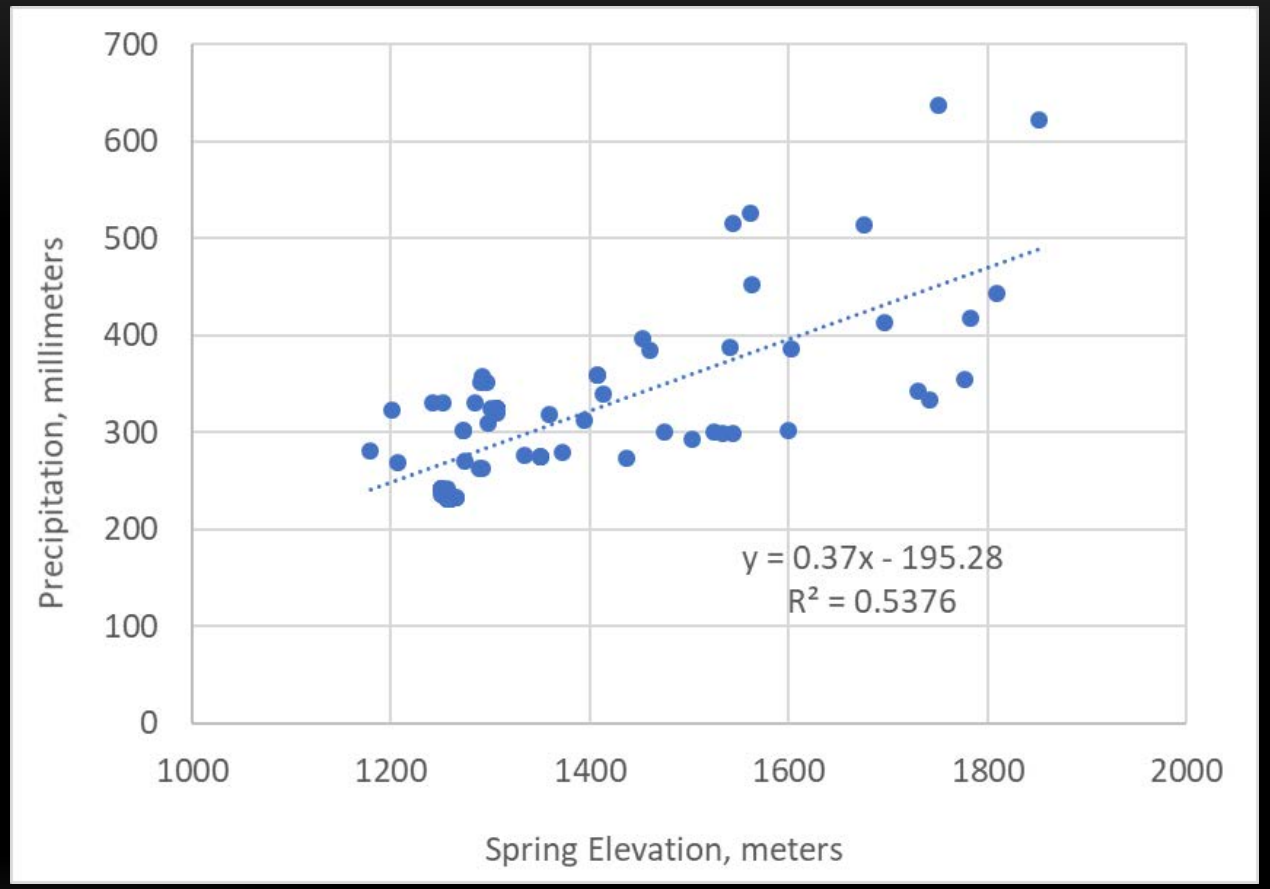
ELEVATION IS CORRELATED WITH MEAN ANNUAL PRECIPITATION





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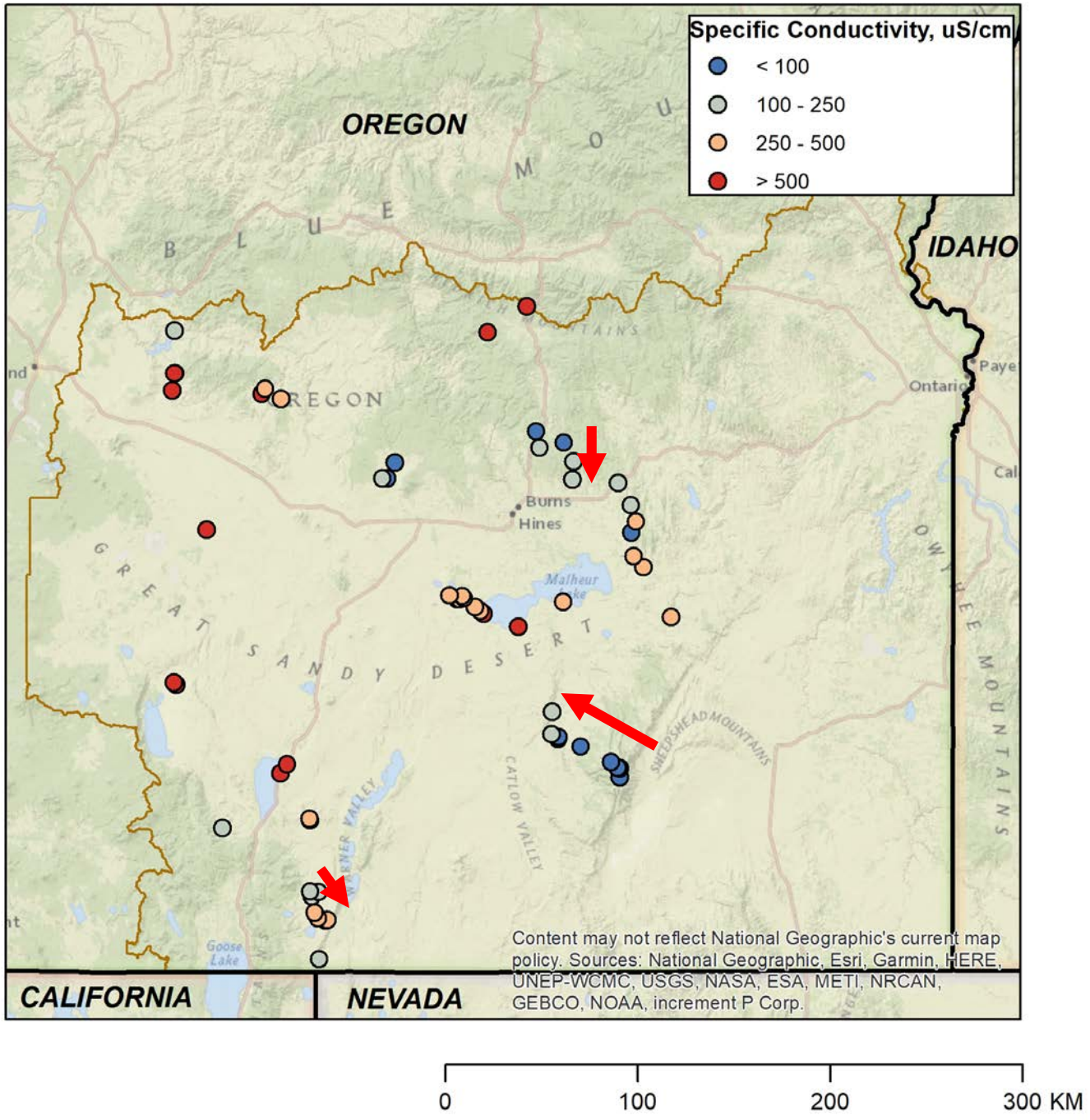
- *1981-2010 Mean annual precipitation from PRISM Climate Group, http://www.prism.oregonstate.edu/*

SPECIFIC CONDUCTIVITY IS LOWEST IN UPLAND SPRINGS AND HIGHEST IN BASIN FLOOR SPRINGS



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TEMPORAL VARIABILITY

Regional Springs

	Range of Values		
	Temp., °C	SC, as percent of minimum	δ^2H, per mil
HUGHET SPRING	0.4	9	
HIBBARD SPRING	0.1	1	0
BARNYARD SPRING	0.3	1	
DOUBLE O COLD SPRING	0.5	2	0
PAGE SPRINGS	0.5	6	2

Little seasonal variability

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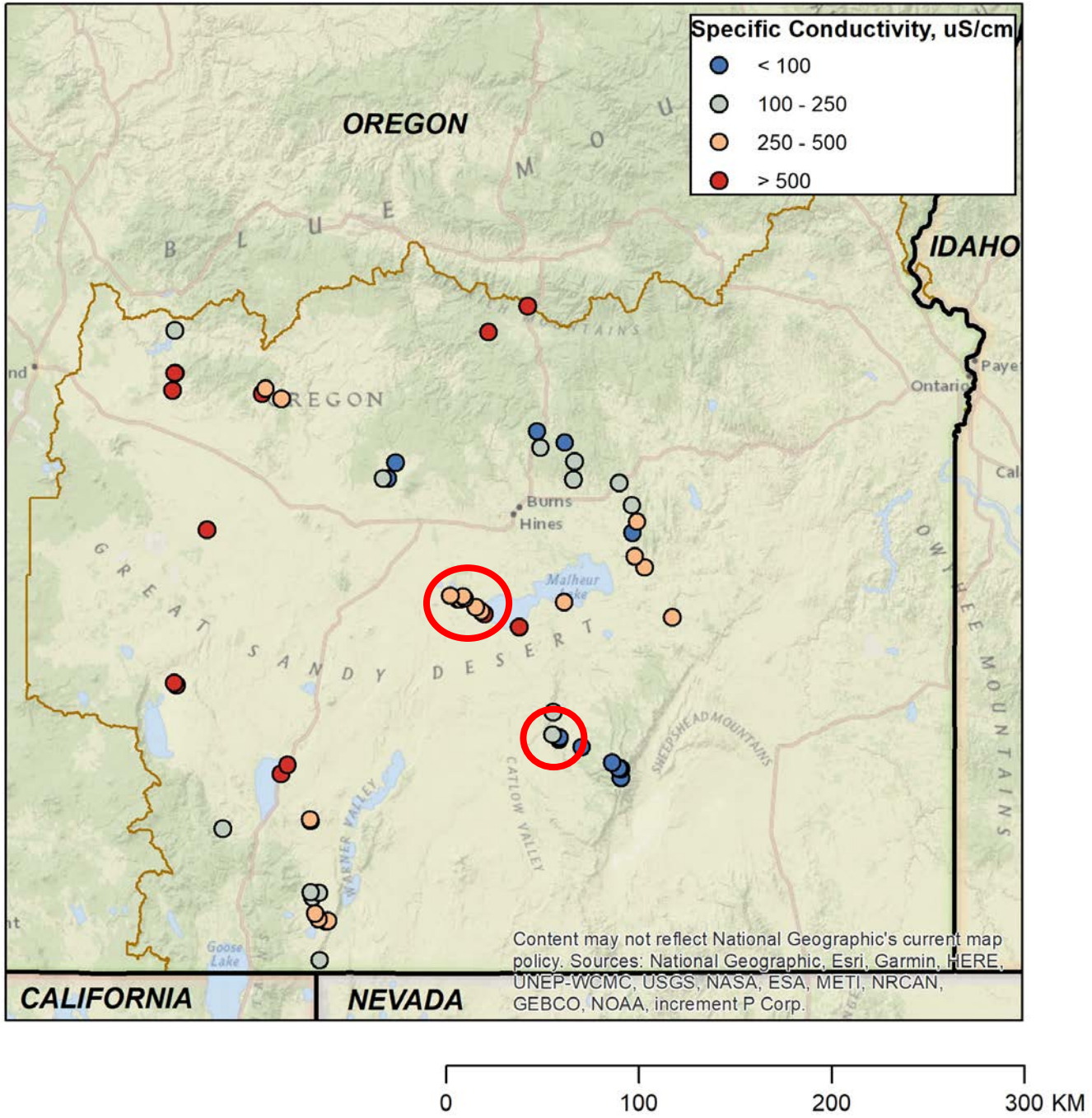

TEMPORAL VARIABILITY

Upland Springs

	Range of Values		
	Temp., °C	SC, as percent of minimum	δ^2H, per mil
INDIAN GRADE SPRING	2.3	31	8
SILVER CREEK SPRING	0.6	13	3

Chemistry responds to seasonal precipitation

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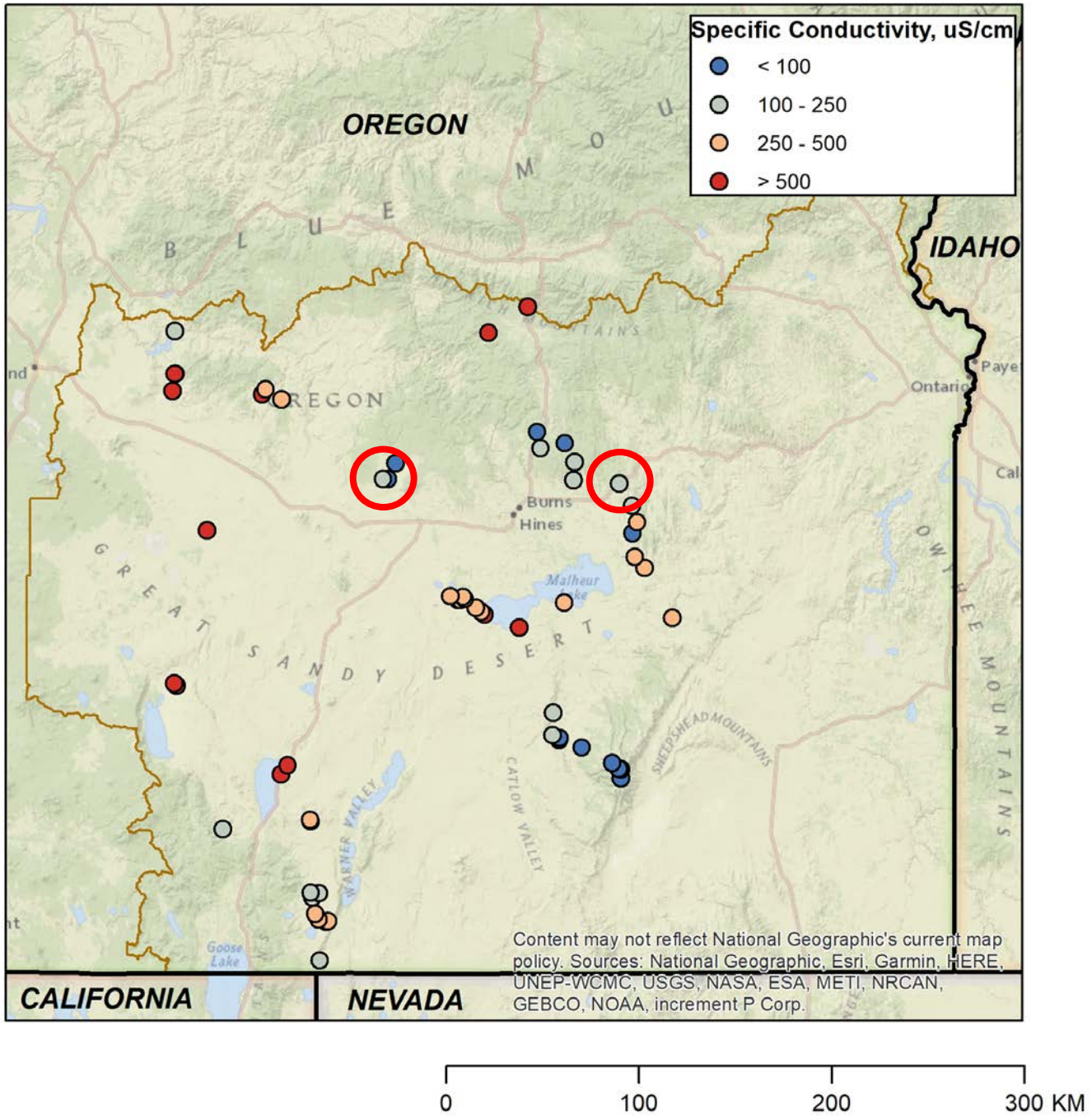

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- Oregon Water Resources Department (OWRD)

Collaborating Organizations

- U.S. Geological Survey (USGS) Northwest Climate Science Center
- USGS Lower Gulf Science Center
- USGS Nevada Water Science Center
- The Nature Conservancy (TNC)

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End of Presentation