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Does Wildfire and Cheatgrass Invasion in a Sage-steppe Ecosystem Change Soil Texture?

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Does wildfire and cheatgrass invasion in a sage-steppe ecosystem change soil texture?

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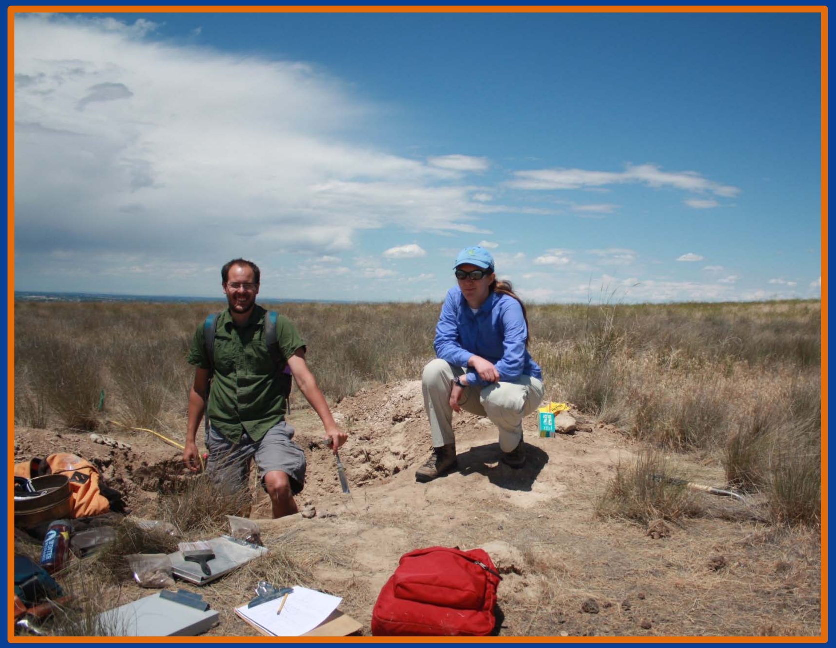
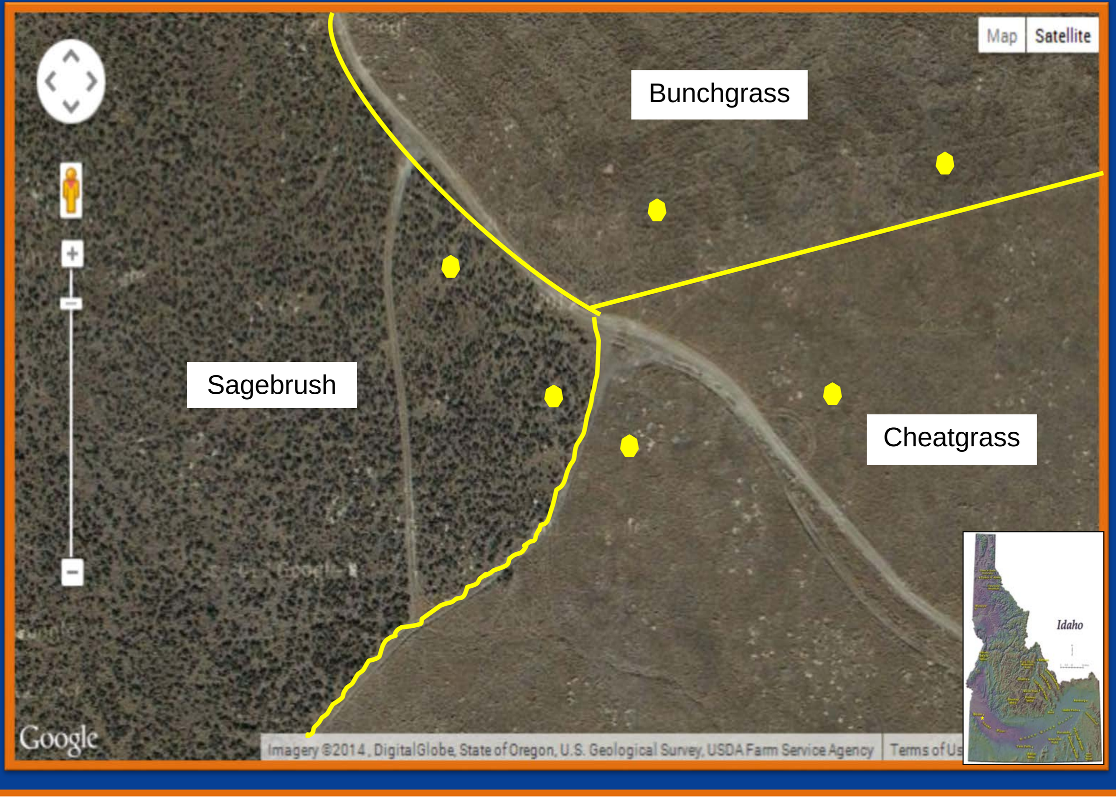
ABSTRACT

Fire and land-use changes influence vegetation types and alter below-ground carbon storage and soil characteristics; additionally, shrub-steppe environments are prone to cheatgrass invasion and subsequent alterations in soil morphology and characteristics following fire. We compared soil particle size, texture, consistence, structure, color and pH among adjacent but distinct sagebrush (*Artemisia tridentata ssp.*), cheatgrass (*Bromus tectorum*) and crested wheatgrass (*Agropyron cristatum)* communities established following a 1983 fire in the Kuna Butte area of southwestern Idaho, a site underlain by basalt and mantled with loess. Soil characteristics were compared in qualitative field soil profiles (two pits per vegetation type) and laboratory hydrometer analyses from paired sites in different vegetation types. Our data does not support differences in soil particle size (silt, clay, sand) among vegetation types; however, particle size and distribution varied with depth within a single soil pit. Field texture classifications and hydrometer results indicate silt-loam was the most common soil type. We found no substantive change in soil texture with change in vegetation type.



INTRODUCTION

Native vegetation (sagebrush, *Artemesia tridentata*) in the sage-steppe ecosystem provides habitat for a variety of wildlife and protects soil by reducing erosion and contributing organic litter. Cheatgrass (*Bromus tectorum*) invades sage-steppe ecosystems after a disturbance, such as a fire. Fire and vegetation type affect water infiltration and repellency (hydrophobicity) and ultimately influence soil texture (DeBano 2000). We compared field soil profiles and laboratory hydrometer analyses from paired sites in vegetation types to determine the effects of cheatgrass invasion and bunch grass restoration on soil particle size.



STUDY SITE

Our study site (Figure 1) was located on Kuna Butte (43.4457, -116.4474) approximately 3km SSW of Kuna, Ada County, ID. It had three distinct vegetation zones (sagebrush, cheatgrass, bunchgrass). The area burned in 1983, 2000 and 2013. After the 1983 fire, the Bureau of Land Management seeded part of the area with bunchgrass in an effort to restore native vegetation.

METHODS

- Two soil pits (60-80cm) dug in each of three vegetation zones (bunchgrass, sagebrush, cheatgrass)
- Sites designated by habitat: Bunch-Cheat (BC); Bunch-Sage (BS); and Cheat-Sage (CS).
- Soil textures, soil color, and presence of calcium carbonate, were described qualitatively in the field (Utah Geological Survey Standard Methods).
- Lab textures were determined with a Hydrometer Method (ASTM D 422-63)
- Calcium carbonate content was quantified using a pressure calcimeter.

Figure 1

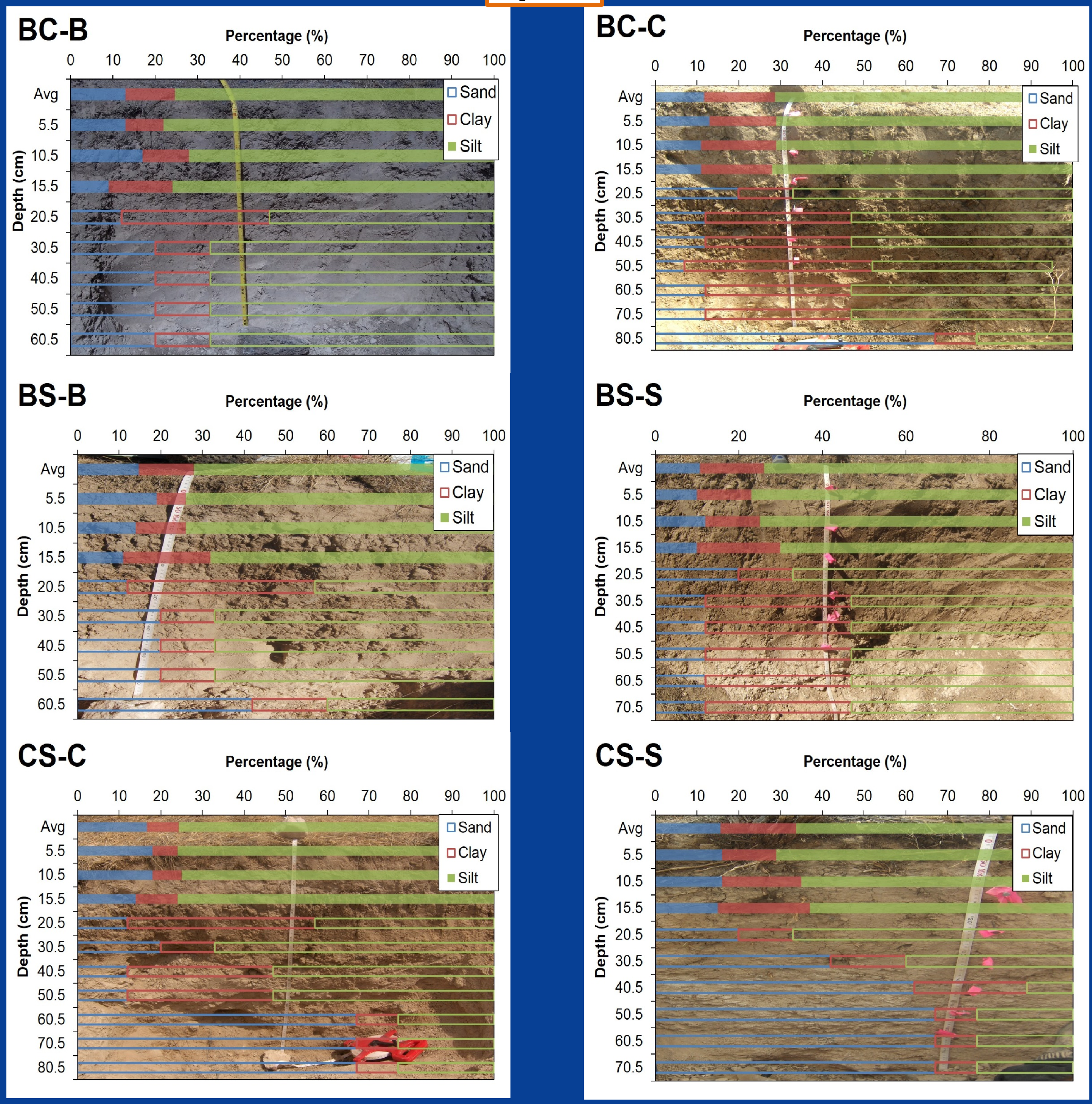


Figure 2

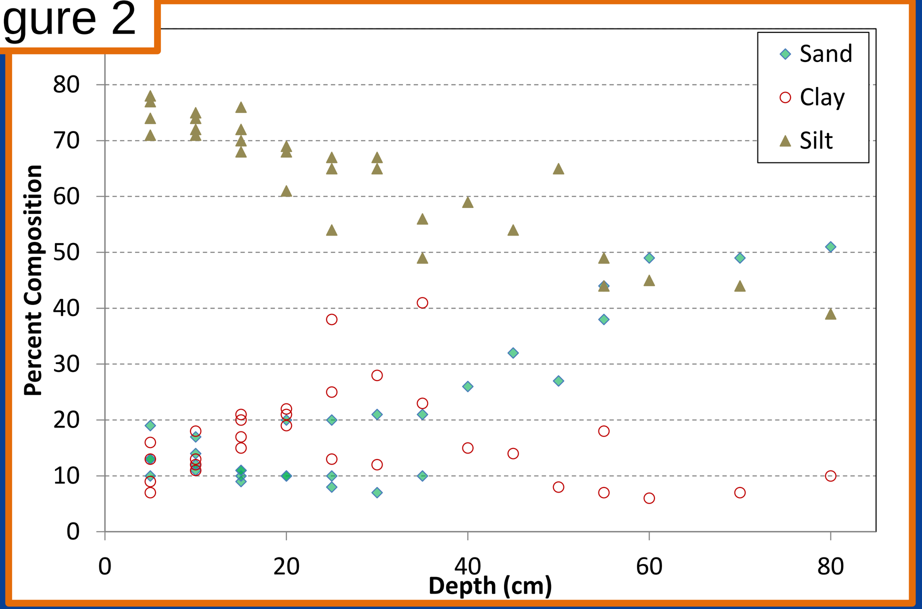


Figure 3

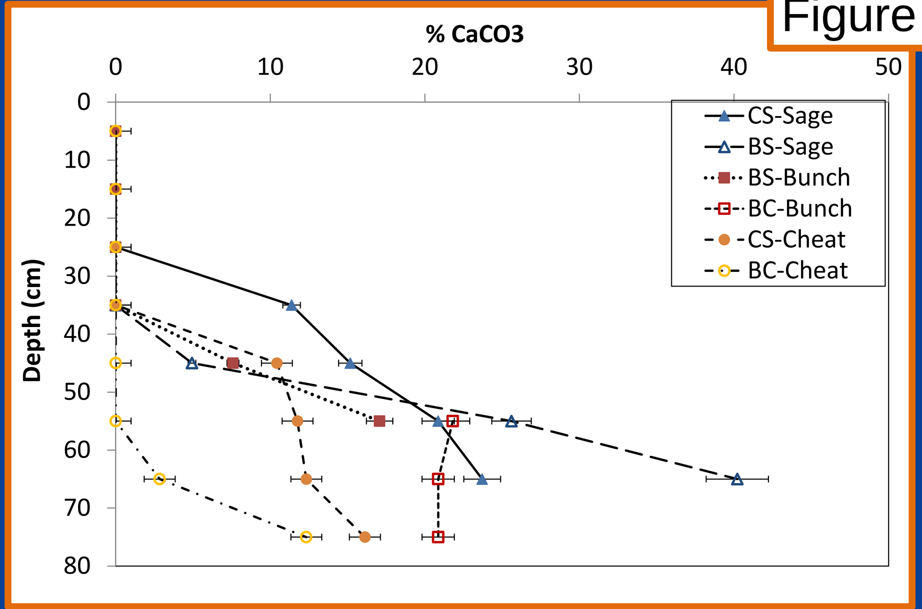


Table 1	BC-B	BC-C	BS-B	BS-S	CS-C	CS-S
Hydrometer	Silt-Loam	Silt-Loam	Silt-Loam	Silt-Loam	Silt-Loam	Silt-Loam
PSA	Silt-Loam	Silty Clay Loam	Silt-Loam/ Silty Clay-Loam	Silty Clay Loam/ Silt Loam	Silty Clay-Loam	Silt-Loam

Table 2	UB1	UB2	UB3	UB4	UB5	B1	B2	B3	B4	B5
Sand	16	12	16	15	15	19	15	15	16	18
Clay	6	3	7	6	5	4	4	3	4	4
Silt	78	85	77	79	80	77	81	82	80	78

RESULTS

- There was no change in soil texture among different vegetation types (Figure 1).
- Silt-loam was the most common soil type (Table 1)
- Field and hydrometer analyses showed similar textural analyses (Table 1).
- Within a soil pit, particle size and distribution varied with depth (Figure 2).
- There were minimal differences between recently burnt and unburnt soil profiles (Table 2).
- $CaCO_3$ (%) increased with depth (Figure 3).

DISCUSSION

- Norton et al. (2004) and Boxell and Drohan (2009) found differences in soil morphology
  - ➢ soil morphology changes due to differences in soil hydrology (infiltration and eluviation rates)
  - ➢ related to stem density of vegetation.
- Our results showed that clay content may not change after fire (Norton et al. 2004).
- The presence of $CaCO_3$ may have influenced soil particle size by causing inaccurate classifications of nodules as sand.
- Similarities in soil textures could be due to:
  - ➢insufficient time for soil development following fire and establishment of vegetation (but see Boxell & Drohan 2009),
  - ➢minimal influence of vegetation type on underlying soil characteristics
  - ➢inadequate sampling and/or sample distribution.

CONCLUSIONS & FUTURE WORK

- Detailed analysis of soil morphology and hydrology might reveal differences among vegetation types.
- Further study would involve more soil pits with greater spatial separation, more samples, and more accurate methods of laboratory particle size analysis (Mastersizer Laser).
- To ensure our field location is not an anomaly, we would duplicate the study in a different location with similar field conditions.

REFERENCES

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