Seismicity and Groundwater Dynamics: Impacts on the Critical Zone in spring of center Mexico

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Introduction

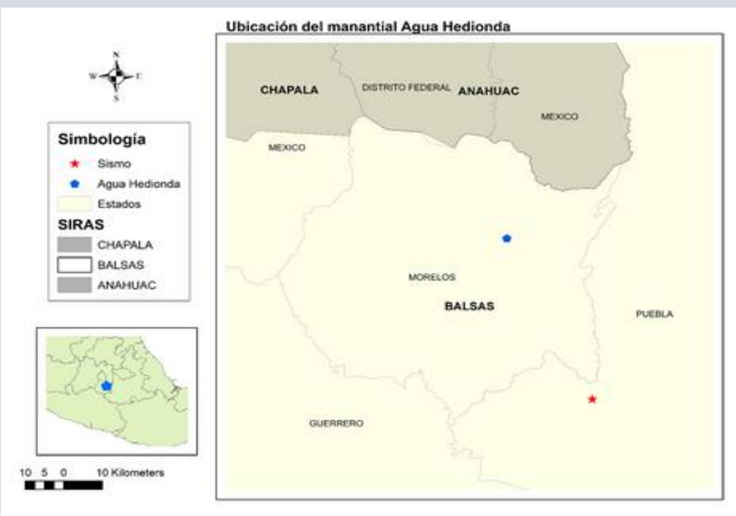

Figure 1. Location of Agua Hedionda spring and the earthquake of september 17, 2017 (SSN,2017).

The Agua Hedionda spring is located in Cuautla, Morelos, México. Within the regional groundwater flow water Balsas.

Geology that influences the spring is composed of:

1. Volcanic rocks: Andesitics
2. Sedimentary rocks: limestones (semi-confining barrier) with gypsum lenses

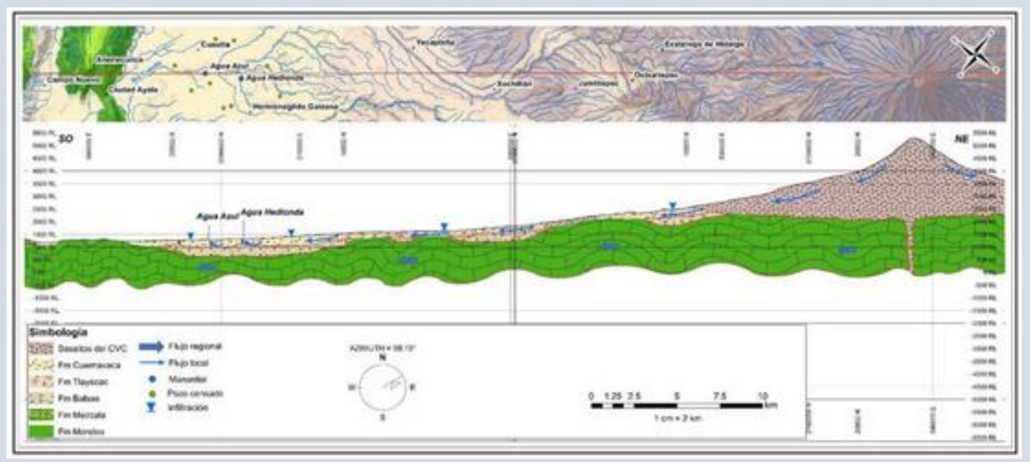

Figure 2. Geological section at the spring (IMTA, 2018)

The 7.1 magnitude earthquake, which was located approximately 50km from the spring, had a substantial impact on the physical and chemical properties of the spring.

Objective

To evaluate the physical and chemical changes in the Agua Hedionda spring related to the 7.1 magnitude seismic event of September 19, 2017.

Methodology

- Bibliographic compilation

  Chemistry

  1995-2018

  Flow rate

  1986-2018.

  Isotopes

  ^{2}H, ^{18}O of the years 1986, 2018.

  ^{3}H y ^{14}C from 2018.
- Sampling at the spring on 2022:

  Chemistry, flow rate and isotopes
- Analysis and results:

  I compared the changes in the spring through time, before and after the earthquake.

Figure 3. Sampling at the Agua Hedionda spring.

Analysis and results

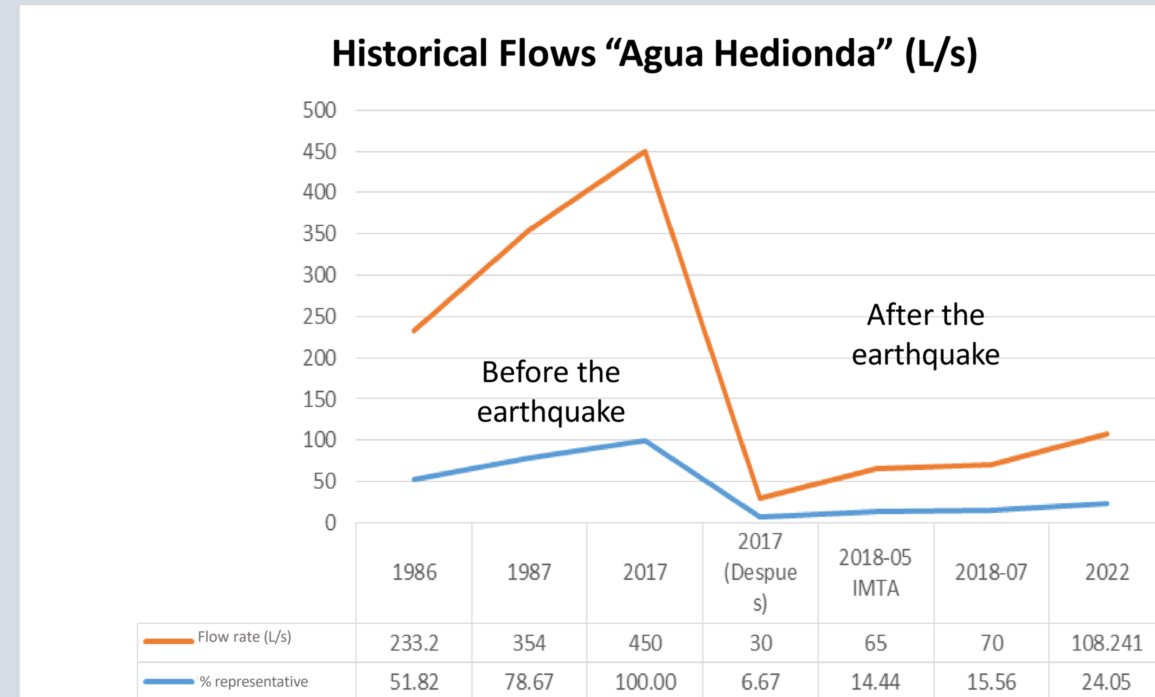

Figure 4. Flow rate of the period from 1986-2022 and loss of flow after the earthquake.

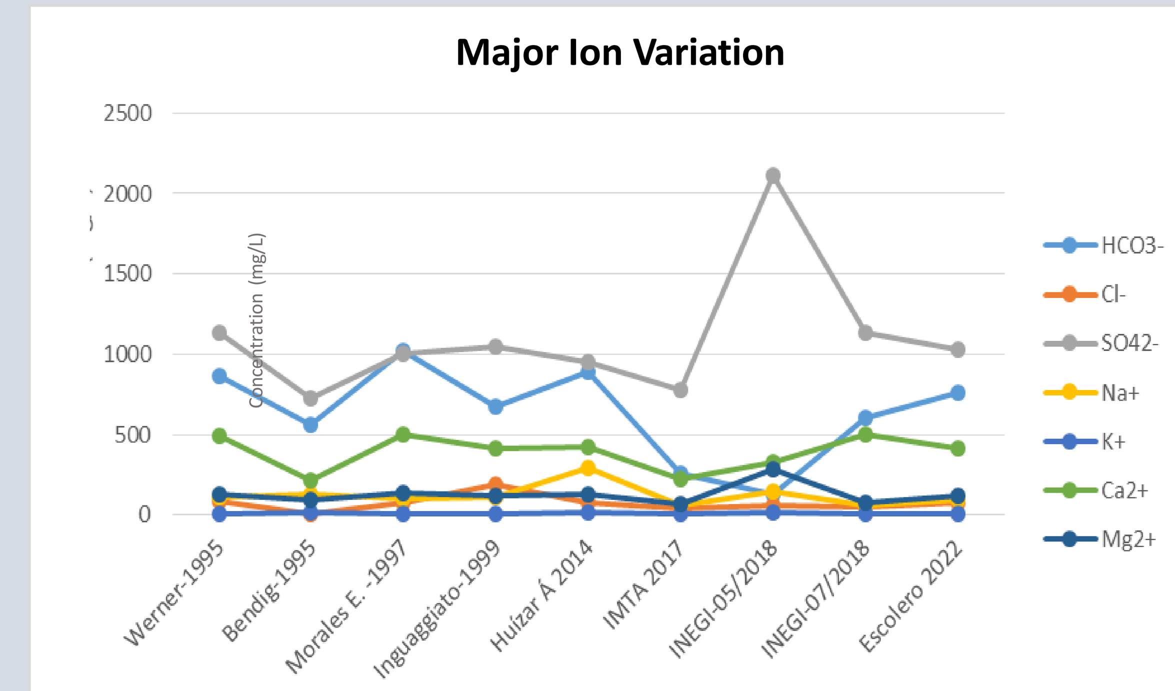

Figure 5. Variation of ions with respect to the time of the Agua Hedionda spring.

In Figure 4 we can observe that after the earthquake the flow received was the lowest in its history.

On other important changes, in Figure 5 we can see the change on the spring's chemistry. All major ion concentrations dropped.

In both graphics, after the earthquake, show a trend of recovery the major ion concentrations and the flow rate.

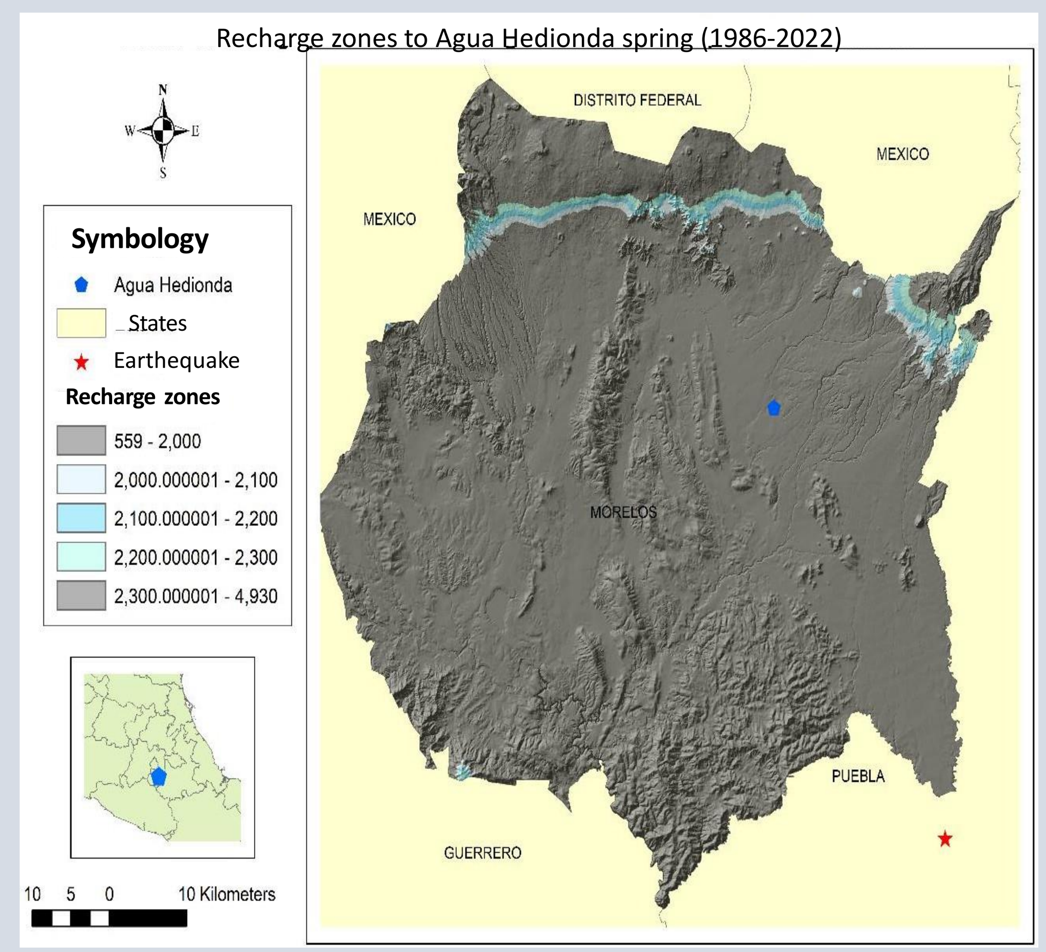

Figure 6. Variability of the recharge zones.

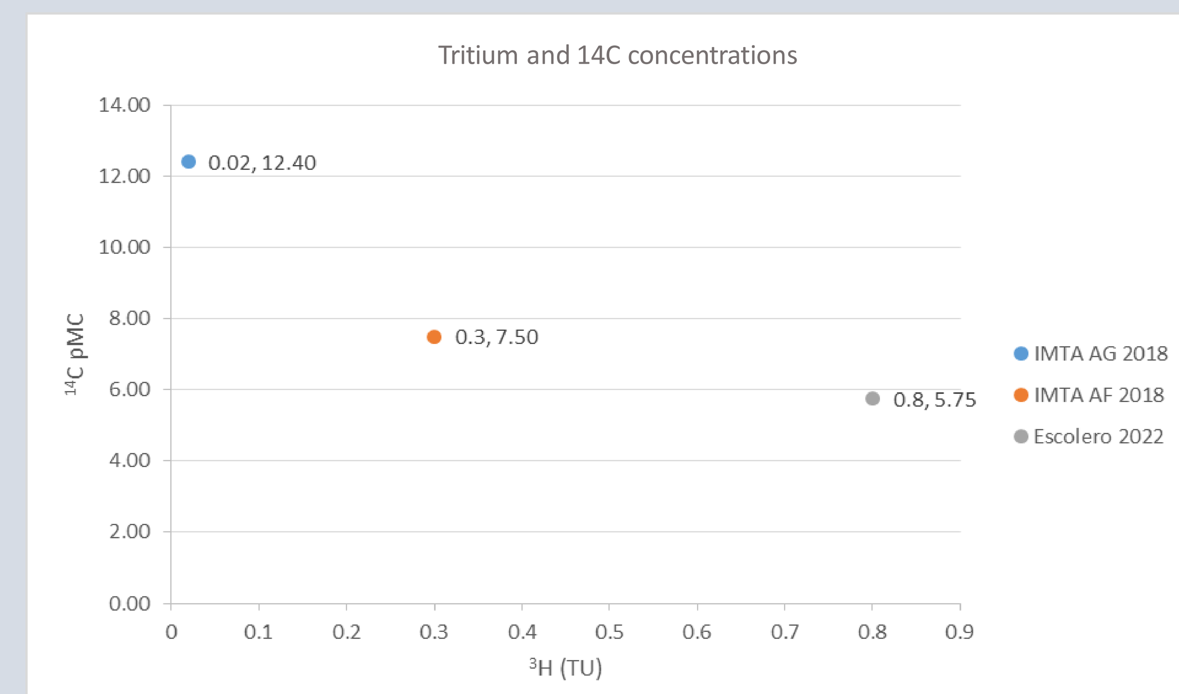

Figure 7. Concentration 14C and 3H isotopes.

I did the correction of residence time only with my sampled data, with the IAE model according to Hann and Plummer (2016). With the correction the residence time of Agua Hedionda spring is 9878 years.

The recharge zones (Figure 6) were calculated with stable isotope concentrations. The variability of the recharge zones in the calculated time frames was low. So the changes of the chemistry of the spring were the result of a post-infiltration phenomenon and not a change in the recharge zone.

With tritium and ^{14}C concentrations (Figure 7) the two samples from 2018 show higher concentrations of ^{14}C than the one from 2022. And on the other hand, the 2022 sample shows higher concentrations of ^{3}H. This could tell us about a mixture between a younger groundwater flow and an older one.

Conclusions

The earthquake had an important impact in the characteristics on the Agua Hedionda spring. The physical and chemical changes in the water suggest a mixture of components within the system or a temporary change in the preferential flow direction, as indicated by the trend of the chemistry and flow rate towards recovery.

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Abstract