



Time and Life in the Silurian: a multidisciplinary approach
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Silurian geoheritage of the Almadén Mining Park (central Spain)

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The Almadén mining district (Central-Iberian Zone of the Iberian Massif) constitutes the largest geochemical mercury anomaly in the Earth's crust. Mercury ore bodies are hosted by uppermost Ordovician, Silurian and Upper Devonian sedimentary and volcanic rocks. In the Almadén-type mineralization, cinnabar and native Hg stratabound orebodies are distributed throughout the uppermost Ordovician to lower Silurian Criadero Quartzite. The Almadén mine ceased operation in 2001 after having produced approximately 200,000 metric tons of mercury during more than 2,000 years of uninterrupted mining by Romans, Arabs and Christians. The mine were transferred to the Spanish crown in the 16th century when mercury became a strategic metal used in the amalgamation of the gold and silver produced in the American territories of the Spanish Empire.

With the great decrease international market price because of declined use of mercury due to its environmental problems, the Almadén mine is now a legacy, yet it retains notable interest from the geological, paleontological and mining perspective. Operative since 2006, the Almadén Mining Park transformed the mining enclosures, the underground mine and the metallurgical facilities into an area for culture, education and quality tourism, where visitors can enjoy the magnificent scientific, industrial and technological heritage of one of the oldest mines in the world adapted to modern times through centuries of technological innovation.

Also planned for the Almadén Mining Park is an Interpretation Centre for understanding the geology and mining activities in the district, which will include information on the stratigraphy and paleontology of the Silurian succession and also on the probable deep-seated (mantle derived mafic magma) source of mercury.

Before the mining activities ended, the present authors (helped by Petr Storch, J.M. Piçarra and F. Palero) collected graptolites between the 10th and 12th floors of the underground mine (about -300 m) from black shales directly above the Criadero Quartzite. A big part of the graptolite collection belongs to the *Monoclimacis griestoniensis* and *Torquigraptus tullbergi* biozones (mid-Telychian) with abundant specimens (other than the named species) of *Metaclimacograptus flamandi* (Legrand), *Parapetalolithus meridionalis* Legrand, *Monograptus priodon* (Bronn), *M. juancarlosi* Storch and *Cochlograptus veles* (Richter), a.o. Older Telychian beds belonging to the *Rastritess linnæi* Biozone are known through old samples coming from the mine, now preserved in museums, as well from a number of outcrops located north and south of the Almadén mine that expose the contact among the Criadero Quartzite and the basal graptolite shales.

Silurian graptolites were discovered in the Almadén mine by Kuss (1878) and Malaise (1897), and after the work of Hernández Sampelayo (1926) and Habberfelner (1931) the mining district became a classical reference for Silurian paleontology in central Spain with some widespread species defined there (for instance *Parapetalolithus hispanicus*).

Besides the projected museum displays on Silurian fossils within the Almadén Mining Park, we are proposing a Silurian geo-route for further demonstration of the stratigraphy and paleontology of the area. Starting at the Interpretation Centre, it will lead visitors to selected Silurian outcrops in the vicinity of the mining park (Lápiz stream, Chillón railway, El Entredicho open pit).

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