Morphology and sedimentary filling of an ancient estuarine valley in an urban environment (Gijón, NW Spain)

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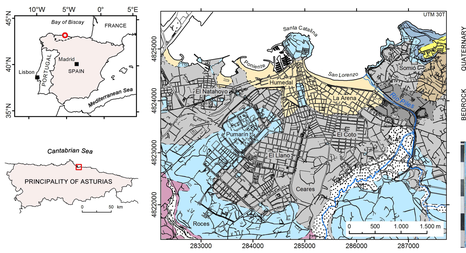
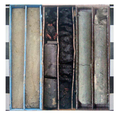
ABSTRACT

This research provides information on the distribution and geometry of coastal sediments in an ancient estuary of the NW Iberian Peninsula, currently occupied by an urban environment. In the city subsurface borehole logs and site observations have been reviewed and reinterpreted. Towards the N, in the submerged area, the conclusions are obtained from a bathymetric reconstruction and a geophysical survey through reflection seismic. All this has allowed to investigate in detail the the thickness of the sediments, the geometry of the paleo-valley filled by them, and to get closer to the bedrock morphology. This type of research is significant for other studies focused, for example, on environmental and sedimentological aspects.

I. INTRODUCTION





Aerial image of Gijón, location and simplified geological map of the city.

1.1. THE STUDY AREA

Gijón is one of the largest cities on the Cantabrian coast, in the northwestern Iberian Peninsula. The urban core, situated 360 km north of Madrid, covers an area of 17 km^2 and its population is around 260,000.

1.2. GEOLOGICAL SETTING

Part of the urban subsurface is formed by sandy sediments linked to an old estuarine mouth barrier (beach and dunes), sand bay and marshes. This Quaternary layer reaches thicknesses greater than 20 m in the northern edge of the city, and represents different climatic stages of the almost disappeared estuary of Gijón. Under these sediments, there are clays related to the weathering of the bedrock whose thickness exceeds 15 meters in some areas. The rock basement under the city is composed of Jurassic carbonate rocks, mainly dolomite, limestone and marlstone. This substrate shows very gentle dips and is affected by subvertical faults.

1.3. OBJECTIVES

The motivation of this research was to improve the knowledge about the distribution and geometry of the sandy sediments. This meant integrating data available on them under the built-up area (mainly boreholes) and information from the submerged área located north of the city. The geometry of these deposits is evaluated as a whole for the first time.

II. METHODOLOGY

2.1. SEDIMENTS IN THE URBAN SUBSURFACE

The distribution and thicknesses of coastal sediments was obtained from site investigations collected within a GIS-type geotechnical database. This information comes mainly from geotechnical reports.

(a) Review of 127 borehole logs (105 crossing sands). Litoral deposits present an average thickness of 7.5 m and maximum value of 21.8 m.

(b) Review of 34 site observations and trial pits.

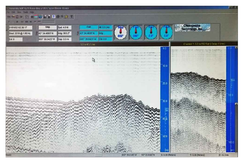
2.2. SEDIMENTS IN THE SUBMERGED AREA

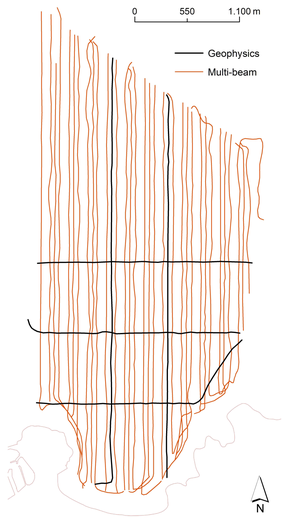
SEAFLOOR MORHPOLOGY

Bathymetric survey with a Odom ES3 multi-beam echo sounder. It involved 42 transects (154.5 km).

UNCONSOLIDATED DEPOSITS

Geophysical survey through high-resolution reflection seismic profiles (5). Equipment Boomer AppliedAcoustics CSP-P & SonarWiz Map4 processing.





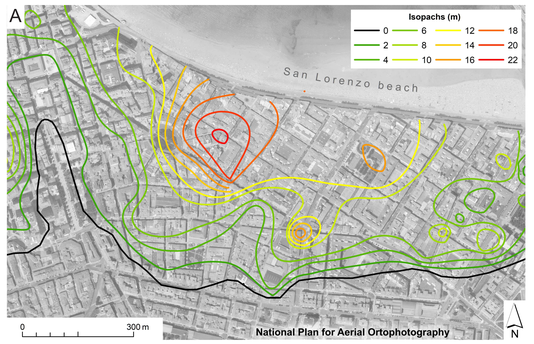
2.3. DATA MANAGEMENT AND INTEGRATION

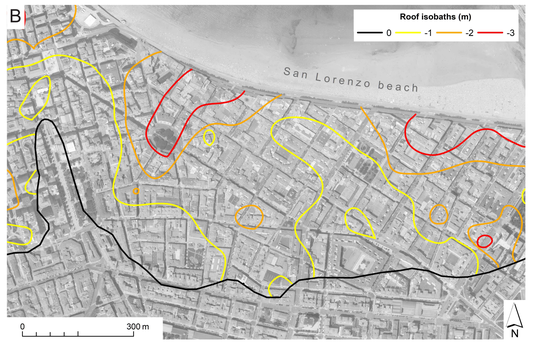
Main GIS-based procedures: exact interpolation, validation of predictions, map algebra, vectorization and 3D visualization.

III. RESULTS

3.1. URBAN SUBSURFACE

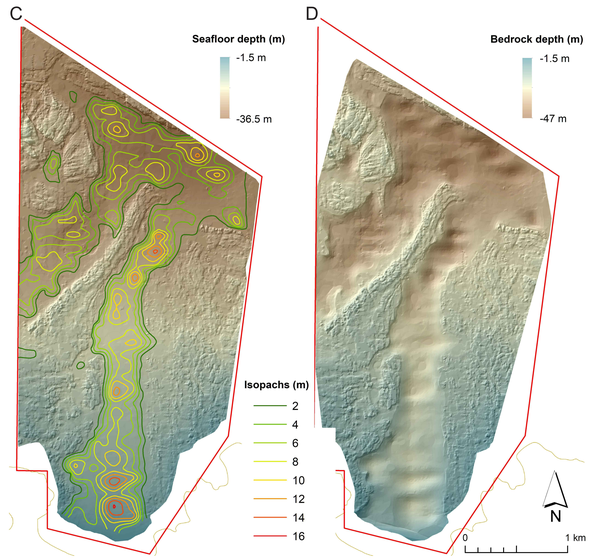
The coastal sediments extend along the entire back of the San Lorenzo beach. In this part of the city they form a strip of 400-550 m inland, and its thickness increases towards the north. The largest accumulations of sand are located in the central sector, with more than 20 m thick identified in some borehole logs. Throughout this area of Gijón these sediments are found at a shallow depth, usually less than 2 m.





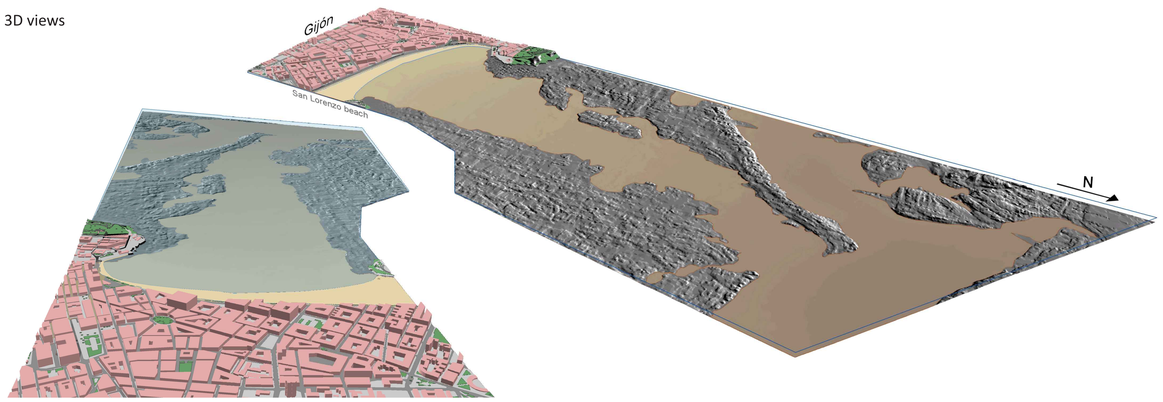
3.2. BAY OF GIJÓN

The bathymetric survey led to a detailed reconstruction of the paleo-valley supposedly excavated by the main river of the city. This channel has a length of about 4 km, a width between 400, and 800 m and a depth of up to 30 m at the northern end. The orientation is N-S and evolves to NNE-SSW towards the north. It shows a sandy bottom with a very low slope (1%), and the unconsolidated deposits reach a maximum thickness of around 15 m.



A. Thickness of sandy deposit below the northern margin of Gijón; B. Depth of the roof of these sediments in this area of the city; C. Bathymetry of the seafloor towards the N and thickness there of the unconsolidated sediments; D. Morphology estimated for the bedrock under the sedimentary filling.

3D views



IV. CONCLUSIONS

- Most of the coastal sediments studied correspond to the San Lorenzo dune field now concealed below the built-up area. This sandy deposit is very shallow, lying at depths not exceeding 3-4 m. Its thickness is maximum in the central sector, reaching punctually more than 20 m thick as evidenced by several borehole logs.
- In the bay of Gijón and towards the N, the bathymetric reconstruction confirms that this sedimentary cover extends by filling a paleo-valley with a length of about 4 km and a very low slope. The geophysical survey has allowed estimating that the unconsolidated sediments have a thickness that reaches 15 m, being higher in the central axis of the valley.
- There is an increase in the depth of the Jurassic bedrock from the city to the N, with a drop in elevation of about 50-60 m to the end of the paleo-valley. This results in an average decrease of 1.3 %.

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