Application of remote sensing data and GIS techniques to the study of the morpho-structural features of extensional basins: an example from the Montefalco area (northern Apennines, Italy).

Michele Santangelo* (1), Francesco Mirabella (1,2), Francesco Bucci (1), Ivan Marchesini (1), Mauro Cardinali (1), Fausto Guzzetti (1)

1. CNR-IRPI, Via Madonna Alta, 126, Perugia.
2. Università degli Studi di Perugia, Dipartimento di Fisica e Geologia.

michele.santangelo@irpi.cnr.it
Outline

Problem statement

Geological framework

Photo-geological mapping

Bedding attitude estimation

Conclusions
Problem statement

Geological field survey is essential for preparing accurate geological maps.

Low local relief, high anthropic pressure, dense vegetation cover, and few outcrops can hamper the quality of the resulting geological maps.

Such features are usually found in intermountain extensional basins filled by Plio-Quaternary sediments.

To what extent can remote sensing data and GIS techniques integrate the geological field mapping in these areas?
Geological framework

Quaternary faults provided the accommodation space for the sediments of the Bastardo basin and the present day valley.
Geological framework
Geological framework

Gravel
Lacustrine silt

Foligno
Montefalco

Image © 2013 DigitalGlobe
Image Landsat
Image © 2014 European Space Imaging

Data di acquisizione delle immagini: 8/7/2013 33 T 304695 02 m E 4750098 69 m N elevation: 333 m altitude: 9.58 km
Aerial photo - interpretation
Aerial photo - interpretation
Photo-geological mapping

Aerial photographs:
1954: 1:33,000 scale, b/w.
1977: 1:13,000 scale, color.

Bedding traces

Lithological boundaries

Tectonic features
Orthorectification

Scan of the aerial photographs

i.ortho.photo

Orthorectification of the aerial photographs

Automatic vectorization

GRASS GIS

ArcScan

ESRI GIS
Montefalco photo-geological map
Montefalco photo-geological map

- Lithological boundaries
- Tectonic features
- Bedding traces
- Study area
Bedding attitude estimation

Bedding trace: intersection line between topography and geological bedding.

The GRASS GIS tool requires in input a bedding traces layer, assuming that it represents a planar surface.

The tool outputs a value of dip direction and dip angle for each Bedding Trace (BT).

Uncertainty of dip direction is assessed as circular variance and angular standard deviation. Uncertainty of dip angle is assigned as standard deviation.
Bedding attitude map
Bedding attitude map
Heuristic bedding attitude domains
Heuristic bedding attitude domains
Heuristic bedding attitude domains
Heuristic bedding attitude domains
Filtering data points...

We selected 208 records out of the original 298 bedding attitude data points. (~70%)

Uncertainty of dip direction estimation decreases with the increasing bedding inclination but...

...field survey and data reveal that bedding steeper than 30° are not expected in the lacustrine sediments of the area...

...we consider unreliable bedding attitude measurements with a circular variance higher than 0.3.
Analytic bedding attitude domains
Analytic bedding attitude domains
What have we learned?

Aerial photo-interpretation allows detecting precious information on bedding attitude, structural features, and lithological boundaries.

Bedding attitude quantitative data can be obtained from a photo-geological map of bedding traces.

Bedding attitude data collected by aerial photo interpretation are better spatially distributed than the traditionally collected field data.

Photo-geological mapping can successfully integrate traditionally collected geological data.
Field trip...
Thank you for your attention