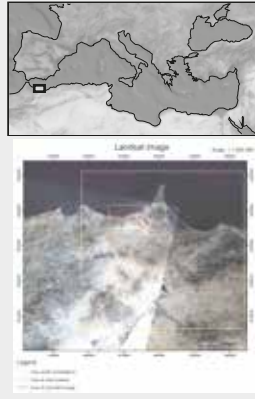




1 Abstract

Caves or shelter are important archives for archaeological research. Prehistoric man set up their camps in caves as well as on open air sites. Since 15 years a joint research group of INSAP (Institut National des Sciences de l'Archéologie et du Patrimoine du Maroc), KAAK (Kommission für die Archäologie Außeruropäischer Kulturen des Deutschen Archäologischen Instituts) and the University of Cologne carries out surveys and excavations in the area of the Eastern Rif (NE-Morocco). Huge parts of the vast working area are hardly accessible and to cover the whole area a remote sensing approach is needed. The aim of work is to integrate high resolute topographical, visual and geological data in order to develop predicting models for site locating. Information from remote sensing (satellite image) and the Geographic Information System (GIS) define the area where the formation of carstic caves is possible and potentially used caves are located. The intersection of geological and topographical maps with QuickBird satellite image could quantify discovered locations of caves. Based on the partially existing fans of sediment in front of the carstic caves potential locations of caves in the defined area could be discovered.



2 Archaeology



Fig.3: Field work at Ifri Armas. The site itself and its archaeological deposits were measured and partly excavated.

Fig.4: Ifri N'Sasch. The site was discovered in 2008 during intensive foot survey

To reconstruct humans history or land use of a certain region from the time before the written records are given, archaeological sites are the only source of information. These sites can be open air locations or caves and shelters. Although cave sites probably were not preferred as habitat, but natural erosion and human land use have perished a high percentage of open air sites so that caves and shelters in many regions are almost the only places where prehistoric deposits are preserved. Another advantage of cave sites is their relative stability. In general they offer protection for several thousand years so that a single cave can contain deposits of very different periods. Therefore caves are also a well suitable location to study very interesting transitional phases like the Neolithisation in the 8th millennium calBP.

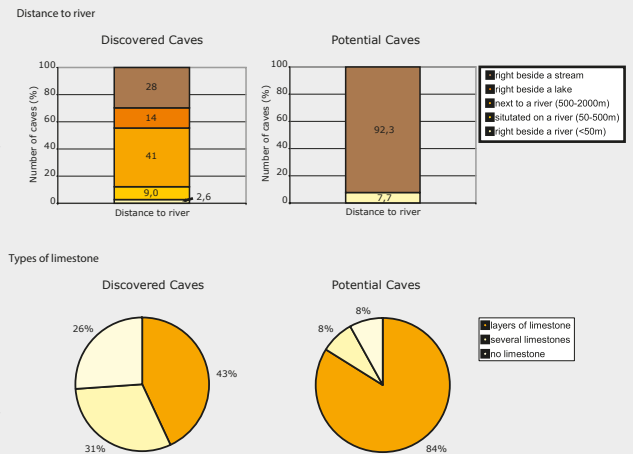
3 Workflow and Methods



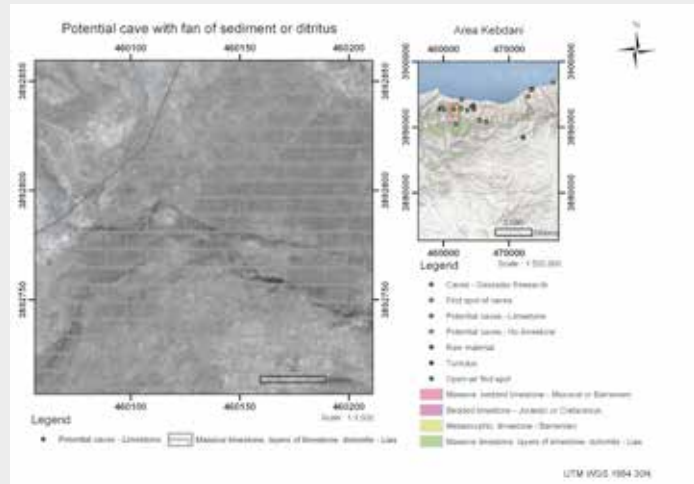
Huge parts of the area of investigation are hardly accessible and to cover the whole area a remote sensing approach is needed. The data used are topographic and geological maps of the area of investigation of scale 1:50.000, QuickBird images of the area of main interest and find spots of the area of investigation (Fig. 2). First of all, topographic and geological maps are cut out and georeferenced in the coordinate system UTM WGS 1985 30N with the help of Landsat images in Geo-Information System. The layers of limestone are digitised from the geological maps. Moreover, the find spots of discovered caves are digitised. QuickBird images are added. Topographic and geological maps, layers of limestone and find spots of discovered caves are blended with each other. The fan of anthropogenic sediment in front of the cave Ifri N'Ammar provided a basis for further investigation in the areas of layers of limestone.

4 Analysis

The analysis deals with the distance between caves and rivers and find spots in different types of limestone. The distance between caves and rivers are detected through scale of the map. Find spots in different types of limestone are worked out by geological maps. Moreover, one must differentiate here because of the different areas of research. The Landsat image (Fig. 2) shows the area of investigation, the area of main interest and the area of QuickBird image, which is analyzed here. The number of discovered caves is 74 and the number of potential caves is 13. The analysis of discovered caves reveals clearly evidence for the use of carstic caves by the anatomic modern human in the closer environment of rivers, which means a distance between 50m to 500m. Compared to the discovered caves nearly all of the potential caves are direct located in layers of limestone and right beside a stream. In part that's because the area of the satellite image is bordered (Landsat image Fig. 2). According to the geological maps several discovered caves are not located in layers of limestone. This can partly be explained by the scale of the geological map (1:50.000) and the related imprecision.



5 Results



The potential caves were marked by fan of sediment or dritrus, which pointed out low from the underground. In the majority of cases discovered caves, which the anatomic modern human used, are detected in a small distance (50-500m) to bigger rivers because of the secure drinking water supply. The hypothesis, which indicates that most of the caves are located in layers of limestone, has been confirmed. According to that further refinement of the area of research should be conducted.

6 Outlook

It would be of interest to survey the potential caves for questioning the used technique. If these potential caves are found in the field, a further prospection using QuickBird images of the areas of the layers of limestone would be advisable.

Acknowledgement

I would like to express my gratitude to Andreas Bolten for his support and friendly and committed mentoring. My thanks also go to Mr. Abdessalam Mikdad from INSAP in Rabat, Marokko and to Mr. Josef Eiwanger from DAI in Bonn, Germany for the putting Quickbird image and find spots at the disposal.