This research is part of a project called “Smiths in Bronze Age Europe”, carried out by the Museo Civico Archeologico Etnologico di Modena within the frame of the OpenArch project, supported by a EU program. The main purpose is to investigate Bronze Age metalworking technologies, with particular regard to the Terramare culture, which developed in the Po Plain (Northern Italy) during the Middle and the Recent Bronze Age (ca. 1650-1560 BC). Accordingly to the traditional goals of experimental archaeology, this research aims to reconstruct the Bronze Age craftsman’s knowledge, techniques and speculations, through the use of archaeological sources concerning metalurgy (casting structures, crucibles, moulds, working tools, slugs, seminished products and artifacts, etc.).

INTRODUCTION
A large number of stone moulds have been found in Terramare sites since 19th century. They were made to produce a wide range of bronze objects, such as ornaments, weapons and tools, but the most represented items are axes and daggers. Empirical observations pointed out that not all the types of stone are adapt to resist to the heat of molten metal.

In collaboration with the Department of Earth Science of the University of Modena and Reggio Emilia, we studied 96 moulds, or fragment of them, found during the archaeological excavations of ancient Terramare and today recorded in the Archaeological Museum of Modena and in the Civic Museums of Reggio Emilia, in order to understand which types of stone were used by the Terramare craftsmen and to find the possible sources of supply of raw materials (Barletta, Lugli 2012).

It seems to exist a correlation between rock types and categories of objects represented on the moulds. The calcarenite was used mainly to produce daggers, small bars and ornaments, that are thin and small objects; while calcareous sandstone was used to produce big and thick objects, like axes and large bars. The biocalcarenite is the most used lithotype, both for objects of reduced thickness and in some cases, greater detail, such as daggers, small bars, rings and razors, both for objects of greater thickness, which are therefore subject to greater thermal shock, such as axes and large bars (fig. 6).

EXPERIMENTAL REPRODUCTION
We decided to produce a copy of an ancient mould made out with one of the principal types of stone used by Terramare artisans, the biocalcarenite of Pantano Formation. After a survey campaign, we have found one of the best accessible source of it: the closest to the plain sites (fig. 5). The aim of this experiment were to test the characteristics of the stone and to verify the level of knowledge and skills required in this kind of production. For this reason we have worked with reproductions of ancient tools like bronze chisels and awls, stone and antler hammers, and different materials documented at that time. The steps of the process are described below:

Step 1. - Sketching out of the block with an antler hammer and a bronze chisel (12% tin).
Step 2. - Forming two quite regular valves with a stone hammer (A river pebble) and a bronze chisel (12% tin).
Step 3. - Scrubbing the two valves onto each other using coarse sand.
Step 4. - Drawing the shape.
Step 5. - Engraving the prolife of the shape with a bronze awl (ca. 4% tin).  
Step 6. - Carving the matrix with a bronze chisel and a stone hammer.

The complete set of implements involved in the process:

- Pre-heating of the mould beside the casting pit.
- Casting the axe.
- Final result.

CONCLUSIONS
This experience documents that the production of moulds for axes can be carried out by non-specialized craftsmen for the following reasons:

- The process itself includes a series of many simple operations (each step might be reproduced also by non-adult male individuals);
- biocalcarenite is easy to work, resistant to heat and durable, thanks to its physico-chemical properties;
- the shape of this simple axes is massive and poor of details, and can be obtained with a monovalue mould;
- the implements involved in the whole process are few and simple.

ANALYTICAL APPROACH
The analyzed moulds are made of fine-grained detrital sedimentary rocks. For the identification of the rock types we took small samples from the original moulds in order to produce thin sections observed at the optical microscope (fig. 3). We identified five different groups of lithotypes: the most represented are the calcarenite and biocalcarenite (fig. 4). Fine-grained carbonate rocks are the most abundant near the area investigated.

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