

Walking with the Unicorn

Social Organization and Material Culture
in Ancient South Asia

Jonathan Mark Kenoyer
Felicitation Volume

Edited by

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Front cover: SEM microphotograph of Indus unicorn seal H95-2491 from Harappa (photograph by J. Mark Kenoyer © Harappa Archaeological Research Project).

Back cover, background: Pot from the Cemetery H Culture levels of Harappa with a hoard of beads and decorative objects (photograph by Toshihiko Kakima © Prof. Hideo Kondo and NHK promotions).

Back cover, box: Jonathan Mark Kenoyer excavating a unicorn seal found at Harappa (© Harappa Archaeological Research Project).



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Ceramic Analysis and the Indus Civilization. A Review

Alessandro Ceccarelli and Cameron A. Petrie

Jonathan Mark Kenoyer has a long history of work with the ceramic vessels of the Indus Civilization and co-authored the most comprehensive assessments of the pottery from Mohenjo-daro yet attempted (Dales and Kenoyer 1986). For archaeologists, pottery is one of the most significant sources of data, not only for the durability and abundance of ceramic artefacts in the archaeological record, but also for the vast range of information on ancient societies that can be inferred from its study. Amongst various approaches to ceramic analysis, two main methods have dominated the field: the morphological approach, where pottery assemblages are grouped according to macroscopic attributes; and scientific analysis, where ceramics are understood in terms of composition and technologies. Even though the latter approach has been tentatively used in the study of ceramic industries in South Asia since the 1930s, it has become significant only in the past three decades. This contribution reviews the use and development of geochemical and petrographic methods for the study of South Asian ceramic traditions, with special emphasis on assemblages produced and used during the Urban and Post-Urban phases of the Indus Civilization (2500-1600 BC).

Keywords: Ceramic Analysis, Pottery, Petrography, Archaeometry, Indus Civilization.

Ancient pottery from sites occupied by Indus Civilization populations has been studied abundantly, but the production, use and distribution of the protohistoric ceramic industries of the Subcontinent are still far from being completely understood (Figure 1). As Dales and Kenoyer (1986: 62) noted thirty years ago, for almost a century, ceramic materials have been mostly examined and defined by types and styles. In many publications, it has been claimed that ceramics have not been subjected to rigorous scientific investigation of chemical and physical properties and manufacturing processes, but a range of geochemical and petrographic studies on Bronze Age pottery types have been carried out during the past decades (e.g. Krishnan 2014). The integration of a range of morphological and scientific approaches has the potential to lead to a comprehensive understanding of ceramic production, use and distribution, which in turn can provide insight into a range of factors related to ancient Indus societies and economies. This contribution will provide a brief overview of the current understanding of Indus ceramics, and assess the use of traditional approaches for the study of vessels, along with some issues related to documentation and interpretation of pottery in the Subcontinent generally. It will then present an overview of the use and development of technological and compositional methods in South Asian archaeology; and finally, it will outline possible future trajectories for the development of the field.

The traditional approach

Morphological examination of vessels is the most common and fundamental analytical approach used to understand archaeological ceramics worldwide. The main features that are taken into account are the

vessel's forms, macroscopic assessment of fabrics, and surface features (Orton and Hughes 2013; Rice 2015). Interior and exterior surfaces can provide details on decorative styles, as well as manufacturing and finishing techniques, which often involves the interpretation of macro-traces on the walls of vessels (see Roux 2016; Roux and Courty 1998; Wright 1989; 1991). This technological and typological classification of 'wares' based on their visual and external attributes can help, with a certain degree of accuracy, to answer questions on provenance, production, use, and distribution of ceramics (Sillar and Tite 2000; Tite 1999). On social, cultural, and economic levels, this traditional approach can be taken one step further, to reconstruct the stories of ancient communities and craftsmanship.

Attempts to provide comprehensive classifications based on morphological examination have been abundantly used in Indus archaeology, and this approach is presented in most excavation reports. The initial accounts of Indus and related ceramics were elementary description of artefacts (e.g. Hargreaves 1929; Stein 1929). Marshall's (1931) volumes on Mohenjo-daro contain a pottery report, but Ernest Mackay's (1938; 1943) monumental publications on Mohenjo-daro and Chanhudaro, Sindh, were the earliest to incorporate observations on a number of macroscopic features of Indus ceramics, including the study of pastes, decoration, dimensions, and frequency of occurrence, as well as making reference to possible manufacturing processes and functions. The latter aspects were also investigated through a comparative analysis of ancient pottery production and modern ceramic traditions in Pakistan, which was one of the most remarkable characteristics of Mackay's work.

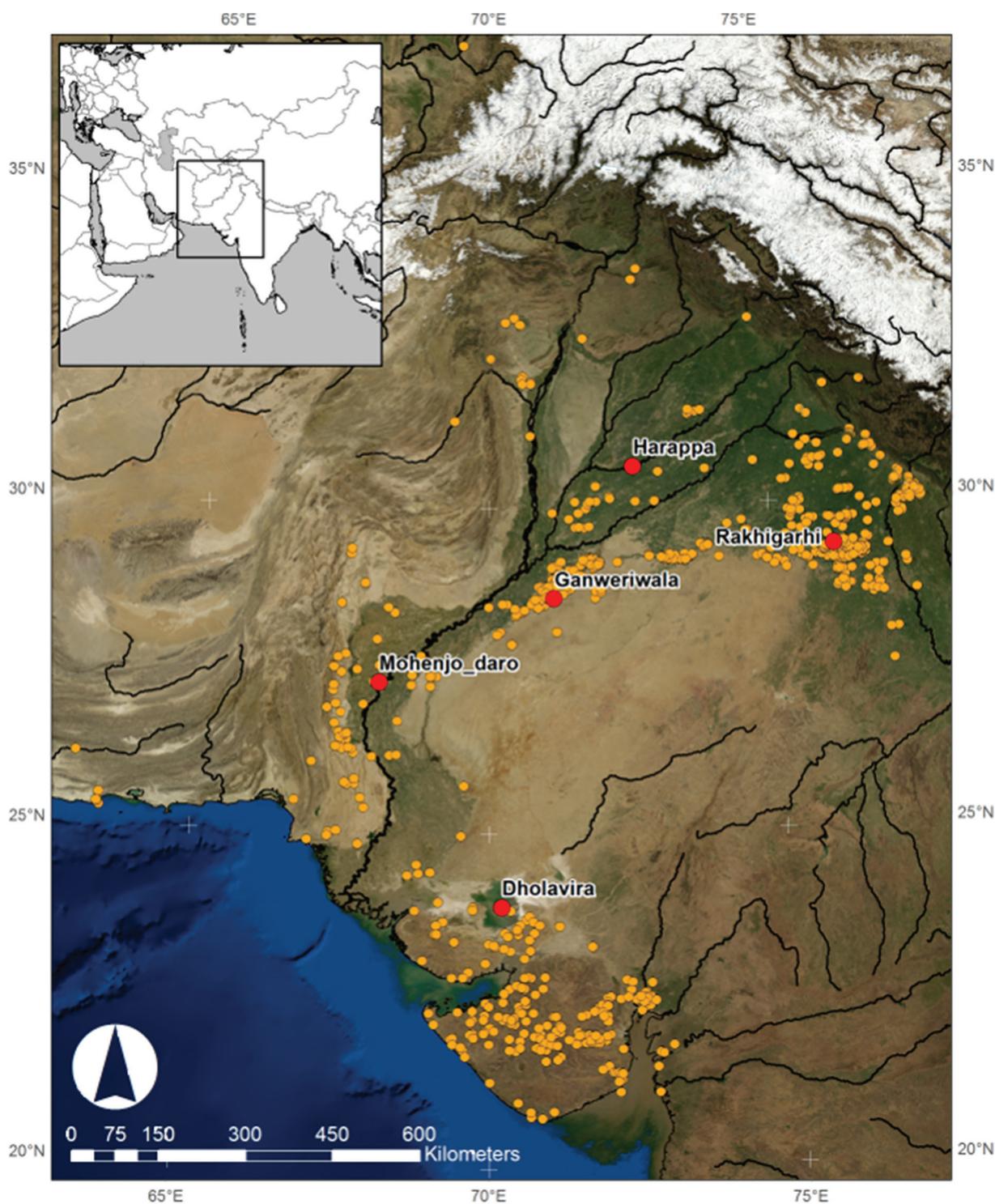


Figure 1. The Indus zone. Map showing distribution of Indus sites during the Urban period (after Petrie *et al.* 2017: 44)

In many ways, Mackay's analysis of ceramics laid the foundation for subsequent publications that discussed ceramics of the Indus period, but the breadth of his approach was not consistently followed. For instance, some of the renowned typological ceramic studies were developed in the early phases of Indus Archaeology by N. G. Majumdar (1934), M. S. Vats (1940), R. F. S. Starr

(1941), R. E. M. Wheeler (1966) and J. P. Joshi (1972). Even though this type of analyses slowly focused more on material found in stratigraphic excavations, they concentrated mostly on morphological aspects, and were lacking certain important specifics. For example, scholars who undertook similar studies often had inconsistent documentation and unclear stratigraphic

provenance of materials, or organised their material by unclear classificatory methods (e.g. Manchanda 1972; Nigam 1979). Thankfully, there have been studies that present a consistent methodology, such as the works of Rao (1963; 1969), Dales and Kenoyer (1986), Herman (1989), Quivron (1994; 2000) and Uesugi (2011; 2016), which are in many ways the pinnacle of typological studies on Indus pottery.

Problems of the Traditional Approach

A comprehensive understanding of Indus ceramics, and broadly South Asian ceramics, has partially suffered from the predominant use of this typological approach, and has often had to overcome four recurrent problems: (1) assumptions on the lack of variability of craft production; (2) undeveloped theoretical frameworks used for the interpretation of ceramic assemblages; (3) the conditions of ceramics found at archaeological sites; and (4) non-systematic documentation strategies.

1. *Typologies and regional diversity.* Assumptions about the lack of variability in ceramic industries are closely connected to the typological approach, and to an unproven – yet widespread – perception of

uniform Indus ceramic traditions. The words of S. E. Piggott (1950) still resound, and the attributes he attributed to Indus pottery have influenced the archaeological research in the region until recent times: ‘stagnation and uniformity’ and ‘monotonous regularity’ are just a few examples of the general traits he associated to ancient industries and artefacts, and these concepts contributed to the imprecise recording and uneven analyses of pottery (Dales 1991; Dales and Kenoyer 1986; Shaffer 1991:448; Wright 1991: 72). The impact of this thinking is clearly demonstrated by Rao (1969: 257), who stated, ‘We all know that the Harappan ceramic wares are uniform throughout the vast region covered by the Harappan Civilisation’.

The early assumption that the Indus region was characterised by homogenous cultural manifestations has led to further simplistic hypotheses (Possehl, 1998: 261–91). For instance, it has been suggested that the Indus Civilization was a vast political entity, dominated by a widespread, standardised agricultural system (e.g. Rao, 1969; Shaffer 1992). In the last thirty years, however, scholars have begun to advocate for a different scenario, where environmental and cultural

Table 1. Some regional pottery traditions during the Indus Urban period.

Pottery tradition	References
‘Classical Harappan Pottery’ or Red Harappan Ware	Rao, 1963; Thapar, 1975; Dales and Kenoyer, 1986; Uesugi 2011; Uesugi 2013; Dangi and Uesugi, 2013; Quivron, 2000.
Kulli Harappan	Possehl, 1986
Punjabi Harappan	Possehl, 1999
Eastern Harappan	Possehl, 1999
Quetta Phase	Fairservis, 1956
Late Kot Dijjan	Dani, 1970-71
Micaceous Red Ware	Rao, 1963; Rao 1985; Herman and Krishnan 1994; Dimri 1994
Sorath Harappan	Herman, 1989; Possehl and Herman, 1990; Sen 2009; Rajesh and Krishnan 2017
Prabhas ware	Subbarao 1958; Nanavati <i>et al.</i> 1971; Dhavalikar and Possehl 1992; Ajith-prasad 2002
Padri Ware	Shinde 1992; Bhagat-Kar, Sonya 2001
Indus Bara Ware	IAR 1954-55; Sharma 1955-56; Sharma 1989; Uesugi and Dangi 2017
Savalda culture	IAR, 1958-59: 16–17; Shinde 1990
Haryana Harappan	Parikh and Petrie 2017
Glazed Reserved Slip Ware	Mackay, 1938; Krishnan <i>et al.</i> 2005
Lustrous Red Ware	Rao 1963; Rissman and Chitalwala 1990; Bhan 1994: 82

heterogeneities in the Indus zone are given a pivotal role (e.g. Chakrabarti 1988; Joshi *et al.* 1984; Petrie, 2017; Petrie and Bates 2017; Petrie *et al.* 2017; Possehl 1982, 2002: 62; Vishnu-Mittre and Savithri 1982; Weber *et al.*, 2010).

Through this perspective, there have now been attempts to reconsider how material culture itself can be used to explore regional crafts and their social implications (Petrie, 2013: 93–95). Table 1 shows some regional traditions of pottery production during the Indus Urban period that have been identified in the past few decades, mostly through visual analysis of available assemblages. This new perception of Indus ceramics is allowing scholars to consider a different scenario, where regional diversity and identity can now be further explored.

2. *Differing theoretical frameworks to the interpretation of ceramic assemblages.* A second problem has sprung from interpretation schemes. In South Asia, archaeological ceramic materials are often used to build seriations – ‘phases’ and ‘periods’ – but they have largely been neglected as a medium through which understanding social aspects of ancient communities can be gained. A great deal of attention has been given to the most notable types of pottery that are archetypal of specific archaeological horizons, with a tendency to discuss either painted pottery, or those wares that have been given some type of cultural identity. In many instances, typological observations of pottery types have been used to identify phases of cultural development, movement of people, and archaeological periods (e.g. Ajithprasad and Sonawane 1994; Joshi 1972; Rao 1963; Sonawane and Ajithprasad 1994; Soundararajan 1962). Distinctive wares from several periods of protohistoric India have been linked to cultural phases in different regions, a number of speculative ethnic groups, which were believed to be responsible for the emergence of new technologies, vessel shapes and decorative motifs. Painted Grey Ware (or PGW) is such an example. In keeping with culture historical approaches, the name PGW has been used to refer to pottery types, cultural complexes (‘PGW culture’, see Roy 1984), areas of archaeological interest (‘PGW sites’, see Singh Daljeet *et al.* 2014), ethnic groups (‘PGW people’, see Lal 1978), and chronological periods (‘PGW period’, see Roy 1983). Similar problems exist with Ochre Coloured Pottery (OCP), Black and Red Ware (BRW), and Northern Black Polished Ware (NBPW), and these names continue to be used in a similar manner.

Likewise, Indus pottery is often presented using catalogues of wares organised by phases and periods and has only been used in a limited way to address questions about the behaviour and

‘social processes’ of communities who produced and used the ceramic materials. This paper only partially addresses issues of interpretations and presents just a few cases of social question-based research projects on Indus ceramics in the *Current Perspective* section. However, it is noteworthy that some scholars have also employed Indus ceramics as a medium for understanding behaviours of ancient communities, including studies on craft traditions and transmission of skills and knowledge (e.g. Kenoyer 1996); ceramic pyro-technologies, Indus urban social unity and hierarchy (e.g. Miller 1999; Pracchia and Vidale 1991); craft specialisation, standardisation and control (e.g. Agrawal 2009:148–150; Kenoyer 1989; Ratnagar 2015: 74–76; Wright 1991); organisation of craft production (e.g. Miller 1994); urban segregation of working areas and stratification (e.g. Kenoyer 1992); movement of goods and exchange (e.g. Méry and Blackman 1996; Kenoyer 1997); symbiotic relationships between Indus ceramic technologies and other contemporary industries (e.g. Anderson-Gerfaud 1989); Indus urban social structures (e.g. Miller 2000); and theoretical and methodological issues of material culture studies in the Indus zone (Bhan, Vidale and Kenoyer 1994).

3. *Fragmentary assemblages.* A second problem that ceramic specialists in the Indus zone have to face is the paucity of complete vessels from the vast majority of sites. Ceramic vessels, especially non-grave pottery, are most commonly found in fragments at urban and rural settlements, and quantifying and documenting materials in a comprehensive and reproducible manner therefore becomes problematic. Some of the methods used for presenting semi-quantitative and qualitative data of ceramic assemblages are unsuitable for documenting incomplete forms. For instance, the classificatory techniques based on the ratio between parts of whole vessels, such as the methods proposed by Dales and Kenoyer (1986), Jenkins (1994), Uesugi (2011: 171), and Vivek Dangi and Samunder (2013) for the study of Indus ceramics, are not suitable when complete vessels, or almost-complete vessel’s profiles are not present in assemblages. Moreover, the fragmentary nature of pottery partially rules out the use of methods for reconstructing each stage of the forming sequence of vessels, such as the approach proposed by Roux (2010; also Roux and Courty 1998) for identifying *chaînes opératoire* and craft traditions. A possible solution to this problem is presented in the next section and in the second part of the paper, where a holistic approach is described.
4. *Documentation strategies.* Finally, there is the problem of sampling and documentation, which are frequently marked by unclear strategies. According

to Krishnan (2014: 235), there has been ongoing debate in South Asia about the best approaches to the illustration, documentation, proper storage schemes, and excavation methods related to pottery. These issues have been long standing, and their resolution is also impacted by the enormous number of sherds which tend to be unearthed at South Asian sites. Mackay (1938: 174) observed eighty years ago that because of the great amount of pottery recovered at Mohenjo-daro, 'It is quite impossible to give a very detailed description of each type. [...] Only pieces of especial interest are described in detail'. This paper will not attempt to provide a solution to this problem, since examples of feasible and effective classificatory schemes are abundantly available (e.g. Orton and Hughes 2013: 275; PCRG, SGRP and MPRG 2016);

Analytical Techniques

Ceramic analytical techniques

Before moving on to the analytical techniques used for studying South Asian archaeological materials, a brief description of the most common methods is provided here. There are a number of well-known techniques for quantitative or semi-quantitative analysis of ceramic data, including ceramic petrography, geochemical analysis, and other mineralogical techniques for the study of clay pastes.

Ceramic petrography. Ceramic petrography involves the description, classification and interpretation of fabrics, borrowing from disciplines such as geology and the sub-discipline of sedimentology for the description of rocks and soil micromorphology. Artefacts are sampled to produce ceramic slides no thicker than 30µm, which are observed under an optical microscope, and to provide an understanding of compositional and structural features (Peterson 2009; Quinn 2013; Whitbread 1989; 1995). Besides giving information about mineral composition, temper, and clay pastes used in the production of ceramics, petrographic studies enable the identification of manufacturing processes often not visible at a macroscopic level. The interpretation of such mineralogical results touches upon provenance studies, movement of materials and people (e.g. Goren 1995; Ixer and Vince 2009; Lombard 1987; Quinn *et al.* 2010), transmission of skills and knowledge, and craft traditions (e.g. Day *et al.* 2016; Whitbread 2001).

Geochemical characterisation. Geochemical compositional analysis is a method for determining pottery composition and compositional groups of ceramics. Some of the most commonly used methods for geochemical characterisation include INAA, SEM-EDS, ICP-MS, and XRF, as they are often considered the best analytical techniques for quantitative measurement of

the major and trace elements (Bishop and Blackman 2002; Maniatis and Tite 1981; Schackley 2011; Tite and Maniatis 1975; Wilson 1978). This approach is largely used for exploring questions regarding clay sources, pottery provenance, regional traditions, and movement of artefacts. It is more suited to determine composition rather than manufacturing techniques, but it is a useful integrative method for classifying ceramic fabric groups based on their pastes (Arnold, Neff and Bishop 1991; Bexter *et al.* 2008; Neff 1993).

Other mineralogical methods. Amongst the other mineralogical techniques available for study of clay minerals and inclusions in ceramic pastes, Fourier Transform Infrared Spectroscopy (FTIR) and X-Ray Diffraction (XRD) are amongst the most established. Clay structure and compositions of clay minerals can be evaluated through FTIR spectral analysis (Berna *et al.* 2007; De Benedetto *et al.* 2002; Forget *et al.* 2015; Schrader 1995) and XRD analysis is used to gain insight into the crystalline phases of clays. These methods are often utilised to get an understanding of the type of clay used in ceramic production, and to identify firing temperatures of ceramic materials such as pottery, bricks and figurines (Barone *et al.* 2003; Jenkins and Snyder 1996; Maritan 2004).

These methods are amongst those most used for the identification of specific physical features of ceramic materials. However, it should be noted that these techniques fulfil their potential when used in a holistic and integrated way to understand the organisation of craft production, and to answer archaeological questions that go beyond the description of artefact structures, compositions and manufacturing techniques (Duistermaat 2016; Shimada 2007; Tite 1999). For instance, a holistic approach advocates the use of combined methods, borrowing from various disciplines. The four major components of this method are: (a) the use of multi-site materials for regional studies, which include clarifications on ancient landscapes; (b) identification of production sites or provenance of materials; (c) an interdisciplinary cooperation between experts, e.g. archaeologists and geologists; and (d) the integration of combined archaeometric techniques, along with experimental archaeology and archaeological ethnography (e.g. Day 2006, 2010). Data obtained through this combined approach can be used to understand the behaviour and 'social processes' of communities who produced and used the ceramic materials (Dobres and Hoffman 1994: 213).

Compositional and technological studies in the Subcontinent

The use of scientific approaches to ceramic analysis in South Asia started in the early 1930s and is tied together with the re-discovery of the Indus Civilization.

Early studies were mostly geochemical analyses on materials from Harappa by M. Sana Ullah (Vats 1940: 468), or from Mohenjo-daro by H. J. Plenderleith (1931), Hamid (Marshall 1931: 331, 689–90), E. Pascoe (Marshall 1931: 685) and M. S. Ullah (Marshall 1931: 688–689; Dales and Kenoyer, 1986: 64). This pioneering work is still mentioned with regard by modern scholars (e.g. Krishnan, 2005: 136) and laid the foundations for subsequent studies on raw materials, decorative pigments and slips. Chemical analysis by Sana Ullah and Pascoe focused on the elements in clay pastes used for pottery making at Harappa and the composition of slips and paints on Mohenjo-daro pottery; Plenderleith's work provided the first microscopic observations on the surface decorations of the so-called Reserved Slip Ware (RSW), and Hamid formulated hypotheses on the nature of grey pigments of Grey Ware Vessels from Mohenjo-daro and contributed to the compositional analysis of raw materials used in ceramic manufacture at the site during the urban phase. Although these early attempts were informative, they were inevitably limited in being focused on two major sites. The need for comprehensive scientific investigation and a better insight into provenance and nature of clays and non-plastic inclusions of Indus pottery became crucial with the recognition of the true extent of the Indus Civilization, and when the wide range of regional types started to be systematically studied (Dales and Kenoyer 1986: 62).

The post-Independence period witnessed the spread of a new trend that motivated scientific studies in the archaeology of South Asia. In the 1960s, the application of analytic methods on copper metallurgical slags provided the first significant study on provenance and production of Chalcolithic copper artefacts from Ahar, Rajasthan. The results could be achieved thanks to the collaboration between a number of institutions, amongst which the Deccan College, Pune, the Department of Archaeology and Museum, Government of Rajasthan, and the Department of Archaeology, Indian History and Culture of the Maharaja Sayajirao University of Baroda (Hegde 1969). In the same years, the compositional and technological study of North-Black Polished Ware (NBPW) was also attempted (Hegde 1962). Such analytical studies echoed soundly in the Subcontinent and led to similar research projects. This novel tendency was identified as and ascribed under the 'New Trends in Archaeology' and presented at the Fourth Annual Congress of the Indian Archaeological Society (Deo, 1972: 129, 133, 188), where the benefits of mineralogical and chemical analysis were briefly summarised by Karunakara, T. M. Hegde and Bal Krishen Thapar. Until the 1980s, the works of Hegde on NBPW (1962, 1966, 1972) and Painted Grey Ware (1975) stood as the primary evidence for the re-emergence of scientific approaches to the study of archaeological ceramic materials in India.

It is worth emphasising that publications on NBPW and Painted Grey Ware by Hegde have been frequently considered as being rare and exceptional scientific studies concerning the chemical and physical properties, and the manufacturing processes of South Asian pottery. In their publication on the Indus pottery from Mohenjo-daro, Dales and Kenoyer (1986) reiterated the views of Shepard (1965) and Matson (1982) in pointing out that the analysis carried out by Hegde stands alone, stating firmly that 'South Asian ceramics have not been subjected to rigorous scientific investigation' (Dales and Kenoyer 1986: 62). Such a view has remained remarkably popular (Chakrabarti 2006: 179).

Current perspectives

With the rise of processual and post-processual archaeology, and the recognized value of scientific techniques for the study of artefacts, approaches towards and perceptions about ceramic materials started to change radically in the 1980s. Human behaviour, cultural choices and the processes involved in pottery use and manufacture have become the new focus of research by archaeologists across the globe, and scientific techniques began to be considered essential for understanding ceramic traditions and ancient societies. In Europe, scholars such as David Peacock (1970), John Riley (1983), Ian Freestone (Middleton, Freestone and Leese 1985), Ian Whitbread (1995), Valentine Roux (Roux 1992, 2016; Roux and Courty 1995); Peter Day (Day *et al.* 2009), Patrick Quinn (2009, 2013), and Evangelia Kiriati (Pentedeka, Georgakopoulou and Kiriati 2012) have laid the basis for a tradition of analytical techniques that can be applied to ceramics. A similar development also happened in North America, with researchers like Anna Osler Shepard (1956), Robert Wallace (Danson and Wallace 1956), Frederick Matson (1964), James Lombard (1987), and James Stoltman (1991).

Meanwhile, in South Asia, the works of Hegde, Herman, Panjwani, Kirshnan, Majumdar and Gogte and several other scholars have played a pivotal role in the field of ceramic analysis and represent an exception to the main trend of traditional pottery studies. The chemical and petrographic studies undertaken by Hegde, Herman, Panjwani and Krishnan on Indus Ceramics mainly deal with provenance, manufacturing techniques and pigments analyses (Herman and Krishnan 1994; Krishnan 1986, 1992; Krishnan and Hegde 1988; Panjwani 1989). Materials sampled in their projects were mostly from sites in modern Gujarat, such as Vagad, Ratanpura, Lothan and Nageshwar. The chemical analysis of ceramics by G. G. Majumdar (1969) on Black and Red Ware, and the X-ray diffraction studies of Gogte (1989, 1993, 1996) significantly helped to develop the field. The above-mentioned works tended to concentrate mostly on the materials and processes

for producing ancient pottery. However, works such as of the study of the Glazed Reserved Slip Ware by Krishnan *et al.* (2005), which combines chemical and petrographic methods, also address certain social aspects of Indus craftsmanship in producing deluxe vessels.

Amongst researchers using a similar combination of methods, and focusing mainly on Gujarati sites, it is worth mentioning Sonya Bhagat-Kar, Prabodh Shrivalkar, Shah Kajal, and A. R. Mishra. The work of Bhagat-Kar (2001) and Shrivalkar (Shrivalkar and Joshi 2008) have dealt with Indus ceramics and Padri ware in Gujarat, while Mishra (2000) and Kajal (2001) presented a scientific analysis of ceramics from Balathal in Rajasthan, and Nagwada and Ratanpura in Gujarat, each investigating fabric composition and ceramic provenance. It is notable that some of these studies emerged from doctoral theses, and some dissertations are still waiting to be published or completed, for example the work of Dheerendra Pratap Singh (2015) on Indus materials from Bahola, Haryana (Singh 2012) and Alamgirpur, Western Uttar Pradesh.

A small number of similar research projects by western scholars have been recently undertaken in South Asia. The most notable cases are the works by Anne Bouquillon (Bouquillon *et al.* 1996), Graham Chandler (2001) and Valentine Roux (1992). Bouquillon completed a combined mineralogical and chemical study of unfired and fired Indus vessels from Nausharo, Balochistan, Pakistan (Jarrige 1991; Méry 1997; Quivron 1994, 2000). Her analyses demonstrated the value of archaeometric techniques for assessing continuity of ceramic recipes from the Pre-Urban to the Urban Indus period at the site. Chandler conducted a sizable petrographic analysis of ceramic from the Pre-Urban Indus period in north western Pakistan. His study intended to provide some basic understanding of the nature of inter-site socioeconomic communication. He set out to obtain data through the use of a portable petrographic analysis kit combined with chemical analysis. Focusing the analysis on two urban sites, Rehman Dheri (Gomal plain) and Harappa (Pakistani Punjab), and two smaller sites, Taraki Qila and Lewan (both Bannu basin), Chandler demonstrated that no evidence of exchange of pottery vessels between the three regions could be observed; however, a certain degree of exchange of knowledge, technology and innovations was proposed. Roux's analyses of archaeological ceramics from Kalibangan (Courty and Roux 1995; Roux 1992; Roux and Courty 1998; Thapar 1975) and comparative experimental pottery made it possible to identify wheel-fashioning methods on the basis of surface features and micro-fabrics, which provide evidence of the complex sequences involved in the forming processes of Indus vessels. Thanks to the support of Dr M. C. Joshi, who served as Director

General of the Archaeological Survey of India in the 1990s, access was granted to the ceramic collection from Kalibangan. Assistance was provided by Madhu Bhala at the Kalibangan section of the Archaeological Survey of India in the study of the ceramics, and overall this study led to a deeper understanding of forming techniques during the Pre-Urban and Urban Indus periods.

Discussion and conclusions

This paper has reviewed the use of morpho-stylistic, geochemical and petrographic methods applied to the study of South Asian ceramics, in particular Indus ceramics and closely related ceramic traditions, during the Urban Indus period.

Some problems related to ceramic analyses have been pointed out, including certain assumptions on the lack of variability of craft production; the different ways in which ceramic assemblages are interpreted; the fragmentary conditions of ceramics found at archaeological sites; and storage and documentation strategies. Amongst them, one of the most crucial issues is the need for nuanced approaches for the collection of quantitative or semi-quantitative data out of fragmentary ceramic assemblages. A combined approach is proposed as a feasible and replicable approach for studying pottery, i.e. a holistic strategy, which can help to understand social dynamics within community dimensions and at a regional level. This requires the integrated use of various techniques, including technological and morphological analyses of vessels, archaeometric methods, and comparative experimental and ethno-archaeological studies.

Contrary to claims by some contemporary scholars, there have been a number of pottery studies on South Asian material that have employed analytical techniques, but they seem to be limited to certain geographic areas (e.g. southern Rajasthan and Gujarat). In many ways, the field of scientific analysis of ceramic materials can be seen to be as old as the re-discovery of the Indus Civilization itself, as the combined use of traditional and compositional methods for assessing ancient pottery was found in early publications on Indus artefacts; nevertheless, the analysis attempted was not comprehensive. Since then, a slow yet consistent tradition of studies has developed in the Subcontinent and continues up to the modern day. Yet, most contemporary scientific works on Indus ceramics appear to deal with materials from the southern and eastern frontier of the Indus zone. This is likely due to the presence of institutions providing resources and training through excavations those specific regions, such as the Department of Archaeology and Ancient History at University of Baroda, Gujarat, the Deccan College Post-Graduate and Research Institute, Maharashtra, and the Department of AIHC

and Archaeology at Banaras Hindu University, Uttar Pradesh.

Given the value of a combined approach to ceramic studies, an obvious future strategy would be to focus forthcoming projects on new avenues of research, including: (1) shifting chronological and geographical horizons of research projects; and (2) adopting nuanced theoretical frameworks. The first suggestion invites researchers to investigate at areas and periods of the Indus zone that are waiting to be fully understood, by using nuanced analytical techniques, and considering materials from large, medium and small-scale settlements, ranging from urban sites to rural villages. The second possible development of the field refers to the use of various theoretical perspectives to address social questions; more specifically, to move away from culture historical interpretations and mere ceramic seriations, and to use material culture as a medium for understanding social, cultural and economic dynamics taking place in the Bronze Age of South Asia. This will contribute to achieve the full potential of ceramic analysis for investigating the Indus Civilization.

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