SERKET سركت

The Arachnological Bulletin of the Middle East and North Africa

Volume 20 **Part 2**

May, 2024 **Cairo, Egypt**

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ISSN: 1110-502X

Serket (2024) vol. 20(2): 58-67.

A new African species of the genus *Leiurus* Ehrenberg, 1828 from Mali (Scorpiones: Buthidae)

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Abstract

A new species of *Leiurus* Ehrenberg, 1828 is described on the basis of one male specimen collected in the mountain system of Adrar des Iforas, Cercle of Kidal, in Mali. The new species, ***Leiurus tamajeq*** sp. n. is most certainly associated to *Leiurus hoggarensis*, described from the Hoggar mountain system in Algeria, both species presenting an almost parapatric geographic distribution. Nevertheless, these closed related mountain systems have been isolated during past palaeoclimatic vicissitudes leading to possible differentiation processes. The two species can be distinguished by a number of morphological characters which clearly suggest that the new species population is distinct from the one found in the Hoggar mountain system. Differences are noticeable notably for morphometric values as well as the relative position of several trichobothria. As for *L. hoggarensis*, the new species seems to inhabit a more mesic zone when compared to the central compartment of the Saharan desert and, apparently, do not present characteristics of a psamophilic species and may be considered as a lithophilic species.

Keywords: scorpion, new species, *Leiurus tamajeq* sp. n., Buthidae, Mali, Adrar des Iforas.

Introduction

In some now old publications produced about 20 years ago, it was already emphasized that the number of new species of *Leiurus* present in the African continent

could be expected to increase rapidly (Lourenço *et al.*, 2002, 2006). The descriptions which really changed most conservative views about this group of scorpions were those of *Leiurus jordanensis* Lourenço, Modry & Amr, 2002 from Jordan, followed by *Leiurus savanicola* Lourenço, Qi & Cloudsley-Thompson, 2006 from Cameroon, representing the second confirmed species from Africa (Lourenço *et al.*, 2002, 2006).

This hypothesis of a rapid improvement in the number of species was confirmed in subsequent publications. A synopsis of these publications was proposed in Lourenço (2020a,b, 2021a) in which most historical aspects concerning the genus *Leiurus* were largely treated; consequently these will not be further discussed here.

This new improvement in the knowledge of the genus *Leiurus* was in part due to new collecting (e.g. Lourenço & El-Hennawy, 2021; Badry *et al.*, 2023) but in most cases due to the existence old specimens available in collections such as that of the Muséum in Paris, but not previously studied. In many, if not most cases these 'old' specimens were collected in regions which are no longer attainable in present days, mainly due to security reasons (Lourenço, 2020a,b, 2021a).

In this contribution, attention is given to one specimen collected more than 30 years ago in the Adrar des Iforas, North of Mali. Until that date it was assumed that only the classical species *Leiurus quinquestriatus* (Ehrenberg, 1828) was present in Africa, and in particular in zones closed to the Malian site such as the Hoggar mountain system in Algeria (Vachon, 1952). However, recently the status of the Hoggar population was clarified and a new species was described (Lourenço *et al.*, 2018). Due to a very limited number of field trips performed in this area, very few species have been reported from the Adrar des Iforas. More recently two species have been described from this area; the first in the genus *Orthochirus* and the second in the genus *Buthiscus* (Lourenço, 2021b; Ythier & Lourenço, 2023). This Malian location represents a totally new record for a *Leiurus* and the second one for this country (Lourenço, 2020b).

Material and Methods

The type specimen was originally conserved dry and posteriorly included in ethanol 70%. Illustrations and measurements were obtained using a Wild M5 stereo-microscope with a drawing tube and ocular micrometer. Measurements follow Stahnke (1970) and are given in mm. Cheliceral nomenclature follows Vachon (1963), while trichobothrial notations follow Vachon (1974, 1975). General morphological terminology mostly follows Hjelle (1990).

Taxonomic treatment

Family **Buthidae** C.L. Koch, 1837
Genus ***Leiurus*** Ehrenberg, 1828

Composition of the genus *Leiurus* in Africa, in order of description (Fig. 13):
L. quinquestriatus (Ehrenberg, 1828) (Egypt, Sudan)
L. savanicola Lourenço, Qi & Cloudsley-Thompson, 2006 (Cameroon)
L. somalicus Lourenço & Rossi, 2016 (Somalia)
L. hoggarensis Lourenço, Kourim & Sadine, 2018 (Algeria)
L. ater Lourenço, 2019 (Chad)
L. gubanensis Kovařík & Lowe, 2020 (Somalia)
L. dekeyseri Lourenço, 2020 (Mauritania)
L. saharicus Lourenço, 2020 (Mali)
L. nigerianus Lourenço, 2021 (Nigeria)

L. aegyptiacus Lourenço & El-Hennawy, 2021 (Egypt)
L. sinai Badry, Saleh, Lourenço & Ythier, 2023 (Egypt)
Leiurus tamajeq sp. n. (Mali)

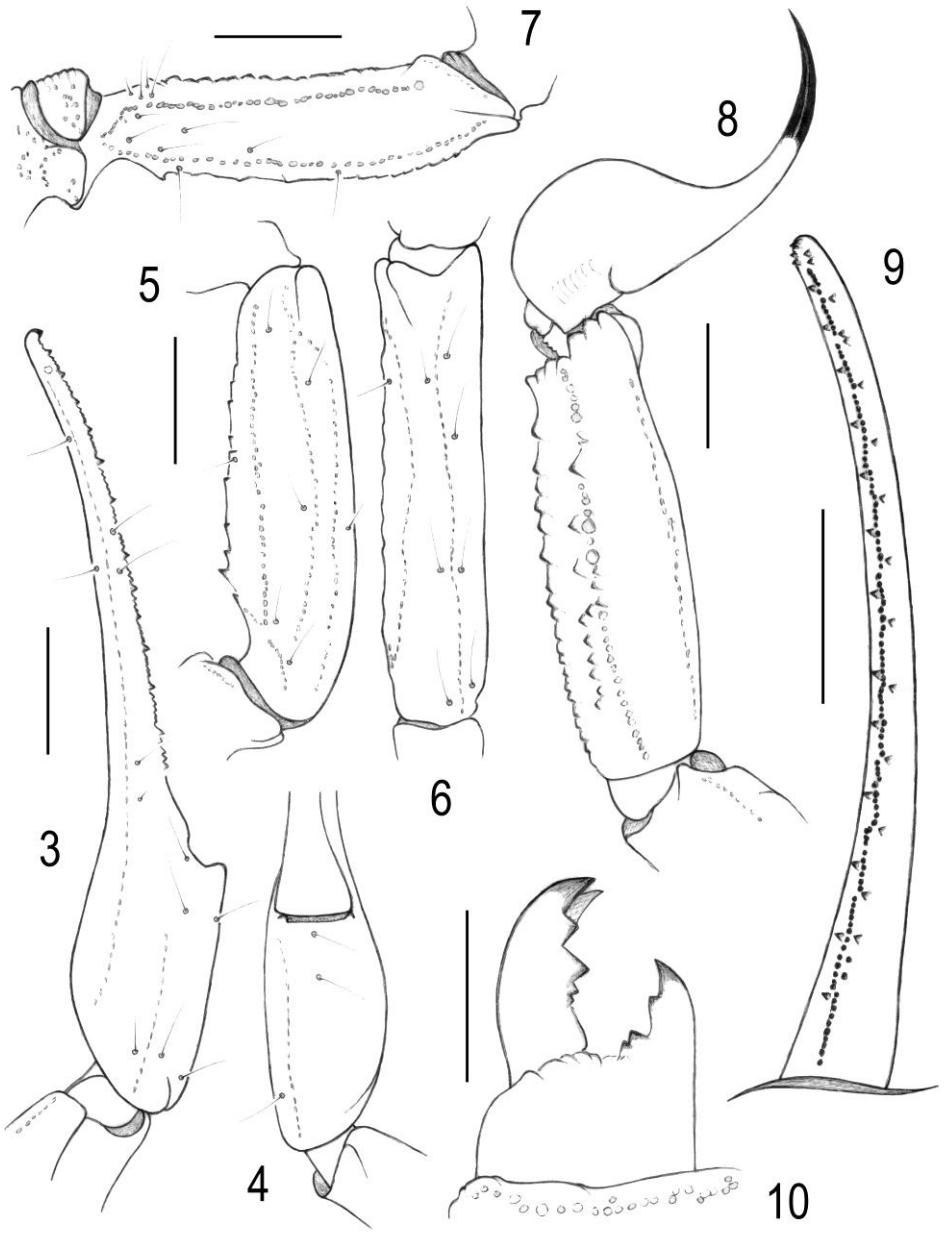
Leiurus tamajeq sp. n. (Figs. 1-10)

Type material: Mali, Adrar des Iforas (Ifoghas), Cercle de Kidal, 680 m. IX/1988 (Ehya Ag Sidiyene leg.) (Figs. 11-12). Male holotype deposited in the Muséum national d'Histoire naturelle, Paris.

Etymology: specific name is placed in apposition to the generic name and refers to the Tamajeq people (Tuareg in Berber language), autochthones to the region where the new species was collected.

Figs. 1-2. ***Leiurus tamajeq*** sp. n., male holotype, habitus. 1. dorsal aspect. 2. ventral aspect. (Scale bar: 2 cm).

Diagnosis: Scorpion of large size when compared with the other species of the genus, having a total length of 84.1 mm for male (see Table I). Ground colour yellow to pale yellow with the body and pedipalps almost totally pale yellow. Male carapace with a slightly brownish zone which covers the ocular tubercle; metasomal segment V only slightly infuscate; other metasomal segments pale yellow. Ocular tubercle moderately prominent. Pectines with 34-34 teeth for male holotype. Median carinae on sternites III-IV moderately marked; sternite VII with mediate intercarinal surface presenting a thin granulation. Pedipalp fixed and movable fingers with 12-13 rows of granules on male holotype.



Figs. 3-10. ***Leiurus tamajeq*** sp. n., male holotype. 3-7. Trichobothrial pattern. 3-4. Chela, dorso-external (3) and ventral (4) aspects. 5-6. Patella, external (5) and dorsal (6) aspects. 7. Femur, dorsal aspect. 8. Metasomal segment V and telson, lateral aspect. 9. Fixed finger showing the rows of granules. 10. Chelicera, dorsal aspect. (Scale bars: 3 mm except chelicera 2 mm).

Description based on male holotype (morphometric measurements in Table I):

Colouration. Ground colour yellow to pale-yellow; body and pedipalps almost totally pale yellow; legs pale yellow. Carapace pale yellow with a brownish spot which covers the ocular tubercle. Mesosoma tergites without infuscations. Metasoma pale yellow on segments I to IV; segment V slightly infuscate. Vesicle yellow with some reddish tonalities on lateral sides; aculeus yellow at the base and dark red at its extremity. Venter yellow to pale yellow without spots. Chelicerae yellow without any reticulated spots; teeth dark red. Pedipalps yellow to pale yellow overall except for the rows of granules on chela fingers which are dark red. Legs yellow to pale yellow.

Morphology. Prosoma: anterior margin of carapace with a weak concavity. Carapace carinae moderately to strongly developed; central median and posterior median carinae moderate to strong; anterior median carinae strong; central lateral moderate to strong; posterior median carinae moderate to strong, terminating distally in a small spinoid process that extends very slightly beyond the posterior margin of the carapace. Intercarinal spaces with a few irregular granules, and the reminder of the surface almost smooth, in particular laterally and distally. Median ocular tubercle in a central position and moderately prominent; median eyes large in size and separated by about two ocular diameters. Four pairs of lateral eyes; the fourth pair is vestigial. Mesosomal tergites I-II pentacarinate; III-VI tricarinate. All carinae strong, granular; each carina terminating distally in a spinoid process that extends slightly beyond the posterior margin of the tergite. Median carinae on I moderate to strong; on II-VI strong, crenulated. Tergite VII pentacarinate, with lateral pairs of carinae strong and fused; median carinae present on the 2/3 of the surface, strongly marked. Intercarinal spaces moderately to strongly granular. Lateral carinae absent from sternite III; moderate to strong on sternites IV-VI; strong, crenulate on VII; median carinae on sternites III-IV moderate. Pectines long; pectinal tooth count 34-34 on male holotype. Metasomal segments I-II with ten carinae, moderately crenulate; lateral inframedian carinae on I moderate; on II present on the posterior 1/4; III and IV with eight carinae. Dorsal and dorsolateral carinae moderate, without any enlarged denticles distally. All the other carinae moderate to weak on segments I-IV. Segment V with five carinae; ventromedian carinae with several slightly spinoid granules distally; anal arch with three lobes, not spinoid. Dorsal furrows of all segments weakly developed and smooth; intercarinal spaces globally smooth, with only a few large granules on the ventral surface of segment V. Telson smooth; subaculear tubercle absent; aculeus as long as vesicle. Chelicerae with two reduced denticles at the base of the movable finger (Vachon, 1963). Pedipalps: trichobothrial pattern orthobothriotaxic, type A (Vachon, 1974); dorsal trichobothria of femur in β (beta) configuration (Vachon, 1975). Femur pentacarinate; all carinae moderately crenulate. Patella with seven carinae; all carinae moderately to weakly crenulate; dorsointernal carinae with 2-3 spinoid granules distally. Chelae slender, with elongated fingers; all carinae weakly marked, almost vestigial. Dentate margins of fixed and movable fingers composed of 12-13 almost linear rows of granules. Legs: ventral aspect of tarsi with short spiniform setae more or less arranged in two rows. Tibial spurs present on legs III and IV, moderately to strongly marked. Pedal spurs present on all legs, strongly marked.

Relationships

The new species clearly shows affinities with *Leiurus hoggarensis* Lourenço, Kourim & Sadine, 2018 described from the Hoggar mountain system in the South of Algeria; both species presenting an almost parapatric geographical distribution.

Table I. Morphometric values (in mm) and selected morphometric ratios of the male holotype and female paratype of *Leiurus hoggarensis* and the male holotype of ***Leiurus tamajeq*** sp. n. (L: length, W: width, D: depth).

	Leiurus hoggarensis		***Leiurus tamajeq* sp. n.**
	Male	Female	Male
Total length	77.7	94.6	84.1
Carapace:			
- length	8.4	10.5	8.6
- anterior width	5.8	7.2	6.2
- posterior width	9.5	12.5	10.2
Mesosoma length	17.8	20.7	19.6
Metasomal segment I:			
- length	6.7	8.2	7.1
- width	5.6	6.2	5.5
Metasomal segment II:			
- length	8.2	9.8	9.1
- width	5.2	5.3	4.8
Metasomal segment III:			
- length	8.3	10.3	9.0
- width	4.7	4.9	4.7
Metasomal segment IV:			
- length	9.1	11.4	9.9
- width	4.3	4.6	4.2
Metasomal segment V:			
- length	10.5	12.5	11.6
- width	4.0	4.6	3.8
- depth	3.6	3.9	3.5
Telson length	8.7	11.2	9.2
Vesicle:			
- width	3.4	4.2	3.5
- depth	3.2	3.8	3.2
Pedipalp:			
- femur length	8.9	11.1	10.3
- femur width	2.2	2.7	2.5
- patella length	9.8	12.3	11.4
- patella width	2.8	3.2	3.0
- chela length	15.8	19.9	18.5
- chela width	2.5	3.2	2.6
- chela depth	2.6	3.3	2.9
- movable finger length	11.2	14.4	13.5
Morphometric ratios:			
- metasomal segment I L/W	1.20	1.32	1.29
- metasomal segment V L/W	2.63	2.72	3.05
- metasomal segment V L/D	2.92	3.21	3.31
- telson L/W	2.56	2.67	2.63
- telson L/D	2.72	2.95	2.89
- pedipalp chela L/W	6.32	6.22	7.12
- pedipalp chela L/D	6.08	6.03	6.38
- pedipalp chela L/movable finger L	1.41	1.38	1.37

Nevertheless the two species can be distinguished by a number of characters: (i) distinct morphometric values for male specimens of similar size-class (see Table 1), (ii) tergites

more strongly granular in the new species, (iii) only metasomal segments I and II present 10 carinae in the new species (I-III with 10 carinae in *H. hoggarensis*), (iv) finally the trichobothrial positions in the new species are marked by several differences: on femur, $\mathbf{d_2}$ is reduced, and $\mathbf{e_1}$ is proximal in relation to $\mathbf{d_4}$ (distal in *H. hoggarensis*); on patella, **i** is more distal and $\mathbf{esb_{1,2}}$ are at the same level ($\mathbf{esb_1}$ proximal to $\mathbf{esb_1}$ in *H. hoggarensis*); on chela fixed finger, **et** and **est** are very closed to each other (well separated in *H. hoggarensis*) and **db** and **est** are almost at the same level (**db** well distal to **est** in *H. hoggarensis*, almost equidistant from **et** and **est**).

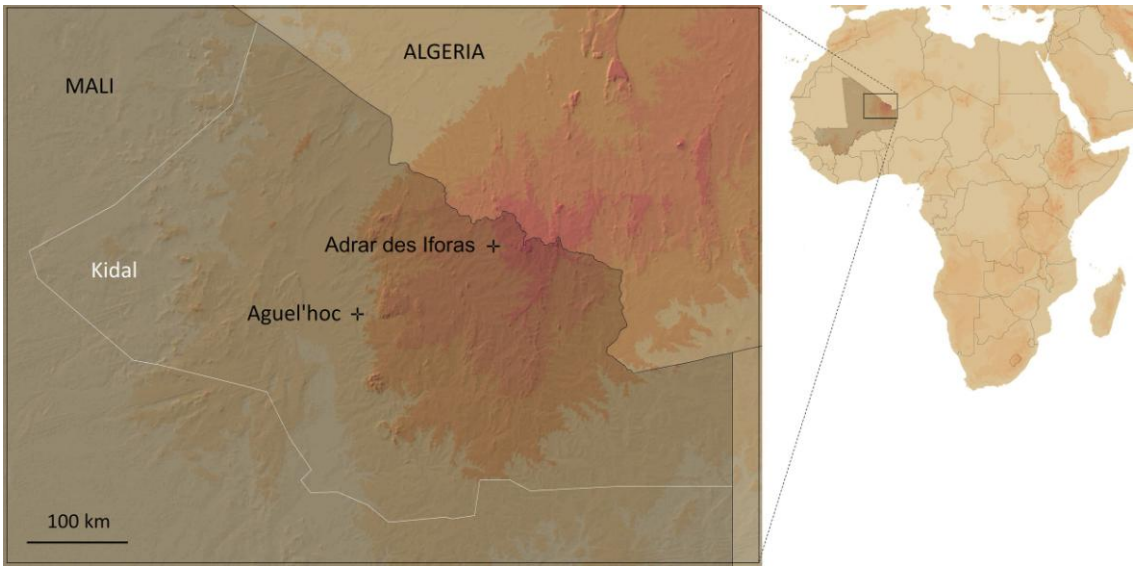


Fig. 11. Map of Mali, showing the general relief of the region and the emplacement of the Adrar des Iforas.

Fig. 12. Adrar des Iforas, Mali (© maliweb.net).

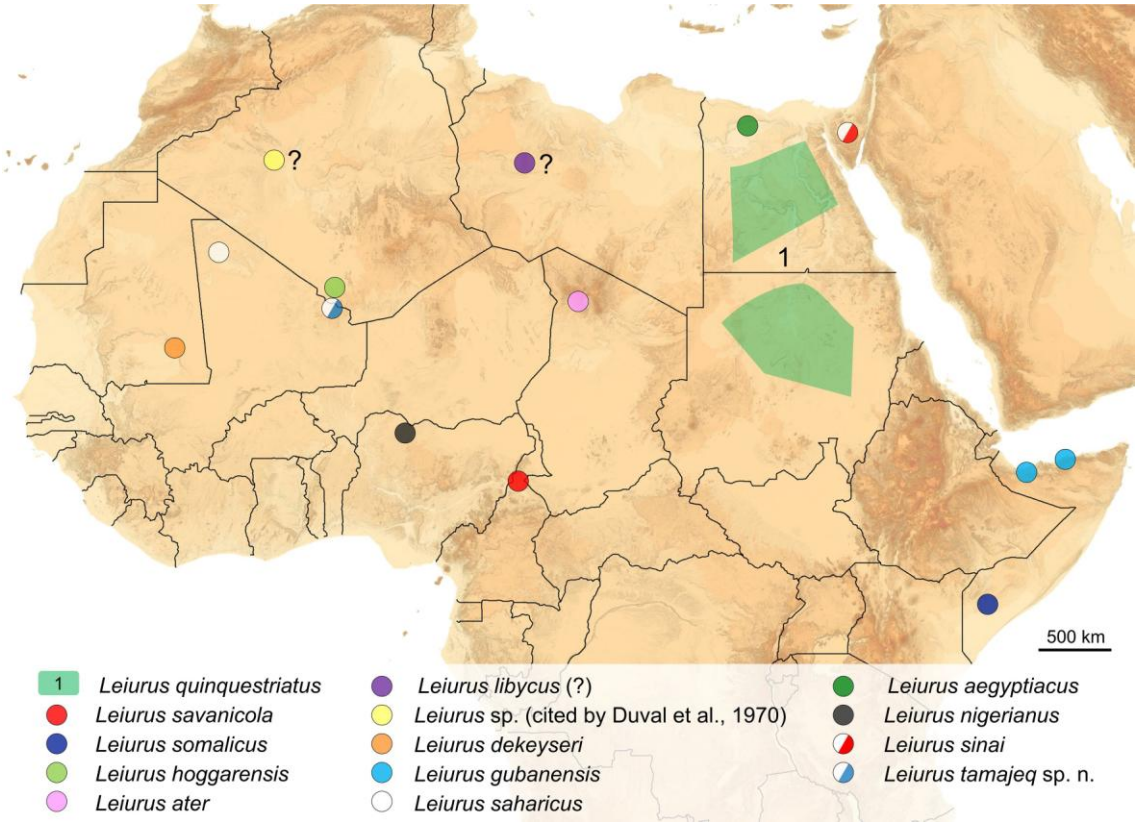


Fig. 13. Map of the North portion of Africa showing the distribution of the known *Leiurus* species.

Some biogeographic comments

As already suggested in previous publications (Qi & Lourenço, 2007; Lourenço & Duhem, 2009; Lourenço *et al.*, 2012), the present composition of the Saharan fauna is, in fact, the heritage of ancient faunas present in North Africa since the beginning of or, at least, middle Cenozoic times. North Africa has experienced numerous palaeo-climatological vicissitudes in the last few million years, some even in more or less recent quaternary periods.

Even if the Sahara Desert is not extremely old as other desert formations in the world, it is possible to postulate that some extremely arid areas have always existed as patchy desert enclaves, even when the general climate of North Africa enjoyed more mesic conditions. In these arid and desert regions, a specialized scorpion fauna would have evolved in response to aridity. These 'ancient lineages' adapted to arid conditions, undoubtedly correspond to several extant groups including the genus *Leiurus*; a number of these groups being typically psammophilic. It is important to emphasise that these lineages have been present in North Africa for at least a few million years (see Qi & Lourenço, 2007 for references). Contrarily, other lineages less well adapted to aridity and, previously only present in more mesic environments, have regressed markedly in their distribution with the expansion of the desert and experienced a form of negative selection. To the best, these populations have been reduced to very limited and patchy zones of distribution, sometimes with remarkable disjunctions in their patterns of distribution.

The patterns observed today in the distribution of North African scorpions can be summarised as follows: 1) a core Saharan region which was defined by Vachon (1952) as

the ‘central compartment’ in which only the groups best adapted to xeric conditions are distributed; 2) a perisaharian zone of distribution which forms a ring around the most arid core region of the Sahara. In this zone can be observed some groups which require more mesic environmental conditions; 3) finally, as already suggested by Vachon (1952), some populations may have their distribution limited to refugia which in many cases correspond to the Saharan Massifs.

The Sahara mountain ranges have attracted the attention of naturalist since the middle of the 20th Century. Some early observations on scorpions were reported for example by Vachon (1950, 1958). These publications, however, were far from satisfactory because the majority of the authors simply associated local species to others already known from other areas of the Sahara. Only more recently new studies started to demonstrate that many of these local populations actually correspond to undescribed and endemic species.

Among these mountain systems some were frequently treated such as the Adrar, Hoggar, Tassili N’Ajjer and Aïr (Vachon, 1940, 1950, 1958) and more recently the Tibesti, Ennedi and Kapka (Lourenço *et al.*, 2012). Contrarily, very few results are available for the Adrar des Iforas, basically only some recent reports such as those of Lourenço (2021b) and Ythier & Lourenço (2023).

Acknowledgments

We are most grateful to Lucienne Wilmé (Missouri Botanical Garden, USA) for the preparation of the maps (Figs. 11, 13).

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