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**Quaternary tufa in the Serra da Bodoquena Karst, West-Central Brazil: evidence of wet period**

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The Serra da Bodoquena is one of the most extensive continuous karst areas in Brazil, located in the Mato Grosso do Sul State, in the central western part of Brazil, on the southern edge of the Pantanal wetland region. It consists of a north-south plateau that extends for approximately 200 km, which forms an important water divide with an altitude of approximately 800 m. The area has a humid tropical climate with average temperatures between 22 and 24°C and an average annual rainfall of 1,419 mm, with 1-3 dry months. In the Serra da Bodoquena karst occurs the best examples of present-day deposition of tufa, along most of the rivers of the region, in the river beds and along their margins, forming dams (Figure 1).



Figure 1: Tufa dams in the Fish River.

Ancient tufas, with Quaternary age, are distributed widely throughout the Serra da Bodoquena, forming unconsolidated micrite deposits at least 290 km<sup>2</sup> in area, forming extensive plains (Sallun Filho and Karmann 2007). These deposits can be identified adjacent to fluvial channels, presenting either smooth texture or one of irregular winding arcs, and relict fluvial channels. These arcs correspond to the edges of ancient tufa dams, whereas the smooth texture is associated with solid masses of tufa. The ancient tufa deposits indicate that the deposition was more extensive than today suggesting a wet period. Near to Serra da Bodoquena, Bezerra (1999) establishes a change to a more humid climate between 10,200 years B.P. and 5,190 years BP. Radiocarbon ages of the mollusc shells (3,820 years BP) recovered from limestone beds (tufa) in the Miranda-Aquidauana wetland, suggests the recurrent of dry conditions during some periods of the Holocene in Pantanal wetland area (Assine & Soares 2004). Laminated sequences of speleothems from João Arruda Cave (Bonito, Serra da Bodoquena) indicates a Constant growth of a stalagmite since 3,800 BP until the present (Bertaux *et al.* 2002). The tufa deposits are used in ancient climatic reconstructions in several parts of the world, associated with geological, geomorphological and biological proxy records. Data obtained from tufa in Serra da Bodoquena are here used as paleoenvironmental indicators. Mollusc shells supplied with maximum ages (<sup>14</sup>C dating - AMS) changeable from 4,840 to 4,780 cal. yr BP, and the  $\delta^{13}\text{C}_{\text{PDB}}$  values for shells oscillated from -10.8‰ to -9.9‰ (Table 1). Tufa supplied with maximum ages (<sup>14</sup>C dating - AMS) changeable from 6,530 to 6,310 cal. yr BP, with the  $\delta^{13}\text{C}_{\text{PDB}}$  value the -8.9‰. Organic sediments, near to the recent river, supplied with maximum ages (<sup>14</sup>C dating - AMS) changeable from 670 to 550 cal. yr BP. After the  $\delta^{13}\text{C}_{\text{PDB}}$  obtained from organic sediments is concluded that they are composed dominantly by remains of C3 photosynthetic cycle (arboreal) plants, because the recorded value the -21.0‰. Ages of others tufa deposits obtained by Turq *et al.* (1987) and Boggiani *et al.* (2002) were re-calculated with *INTCAL04 Radiocarbon Age Calibration* (2004), being obtained ages from 3,835 to 3,479 cal. yr BP and 2,313 to 1,986 cal. yr BP for tufa, 3345 to 1169 cal. yr BP for organic sediments, and 6469 to 5467 cal. yr BP for shell. In west-central Brazil, radiocarbon ages of tufa deposits situated of the 10 to 15 m above present baselvel, suggest millennial scale paleoenvironmental change patterns corretable with the worldwily recognized marine oxygen isotope stages. The obtained data demonstrate that the mid-

Holocene was a wet and warmer climate period and the climate change began in the last 2,700 years BP with the decrease of the rainfall and tufa deposition. These events probably synchronous with orbital changes, and ratified models of the relative sealevel in Brazil, with important negative fluctuation between 3,000 to 2,500 yr BP.

Sample Data	Coordinates	Lab. number	<sup>14</sup> C Age (yr BP)	δ <sup>13</sup> C <sub>PDB</sub>	Calendar age (cal. yr BP)*	deep (m)
X2 – shell <sup>a</sup>	-21°15'4,62"S -56°34'11,43"W	Beta-221513	2630 ±60	-9.9	2850 to 2720	0.30
X1a – tufa <sup>a</sup>		Beta-221514	5650±50	-8.0	6530 to 6310	3.0
X1 – shell <sup>a</sup>		Beta-221512	4200±40	-10.8	4840 to 4780 4780 to 4600	3.0
RP1 – carbon <sup>b</sup>	-21°07'18,96"S -56°43'11,29"W	Beta-221511	650±40	-21.0	670 to 550	1.0
Salobra River – carbon <sup>c</sup> shell <sup>c</sup>	-20°30'20,92"S -56°47'22,38"W	Bondy 66	2150(+ 500- 470)	-	3345 to 1169	1.8
		Bondy 71	5200(+ 240- 230)	-	6469 to 5467	2.1
AQDB-03-A3 – tufa <sup>d</sup>	-21°02'11,80"S -56°51'30,78"W	619/CENA#266	2.130 +/- 60	-5.25	2313 to 1986	-
AQDB-03-B3 – tufa <sup>d</sup>		620/CENA#267	2.420 +/- 70	-5.39	2623 to 2343 2713 to 2628	-
AQDB-03-C3 – tufa <sup>d</sup>		621/CENA#268	3.410 +/- 70	-5.66	3835 to 3479	-

<sup>a</sup> Xaraés Quarry, <sup>b</sup> Perdido River, <sup>c</sup> Salobra River - Turcq *et al.* (1987), <sup>d</sup> Aquidabã River - Boggiani *et al.* (2002)

\*calibrated ages are calculated from Stuiver *et al.* (1998) and Talma & Vogel (1993), assuming two-sigma error on radiocarbon measurements with error multiplier of 1.0; cal. = calibrated.

Table 1: Radiocarbon ages of tufa from Serra da Bodoquena (MS, Brazil). The intervals given in calendar years BP, correspond to maximum and minimum values, assuming a two-sigma error of the radiocarbon measurements.

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