processes

Supplementary Materials

Accuracy of improving ^{14}C method applied in the biomass and coal co-firing power stations

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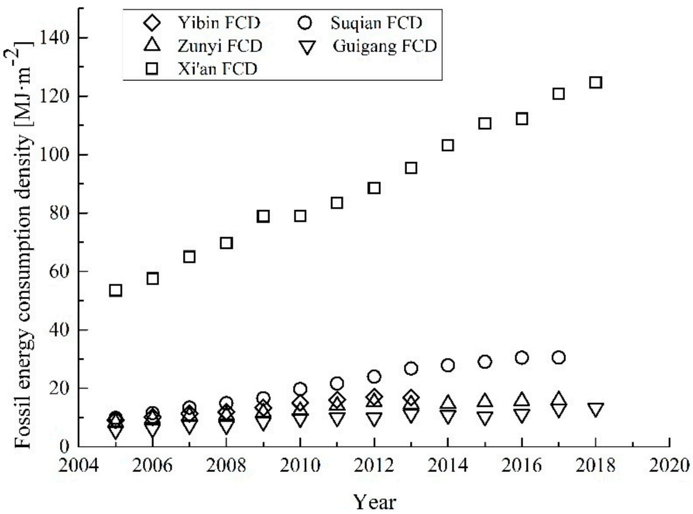
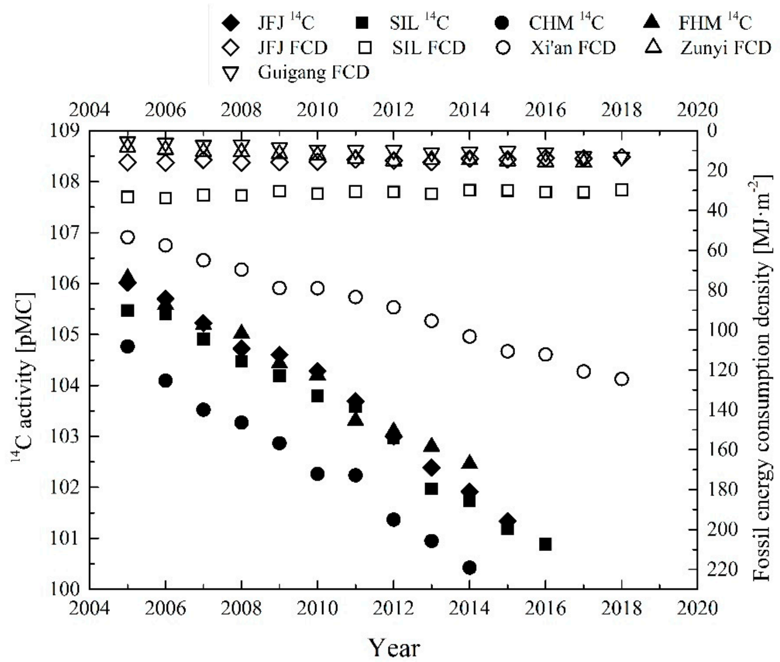
1. Figure Captions

Fig. S1 (b) shows the ^{14}C activity and local FCD of JFJ, SIL, CMH, FHM, GG from 2005 to 2018. In these years, the FCD of Xi'an increased, while other places just changed within a limited range. The FCD value of Zunyi is quite close to that of Switzerland and is slightly lower than that of Germany. Meanwhile, the ^{14}C activities obtained from the three sampling sites are consistent. All the same, there is a huge gap between the FCD value of Xi'an and Zunyi leading to the lower ^{14}C activity of CHM tree rings 2 pMC than that of the Northern Hemisphere atmospheric background, even though all these ^{14}C activity data were sampled from mountains.

According to Fig. S1, GG and SQ may have similar local general atmospheric ^{14}C activity to Zhunyi owing to the same FCD values.



(a)



(**b**)

Figure S1. (a) Local fossil energy consumption density (FCD) of Guigang (*GG*), Suqian (*SQ*) and other places in the period of 2005-2018; (b) ^{14}C activity of samples from Cuihua mountain (CHM) in Xi'an[16], Fenghuang mountain (FHM) in Zunyi[15], Jungfraujoch (JFJ) in Switzerland and Schauinsland (SIL) in Germany[10], and these places' local Fossil energy consumption density (FCD)[17,19], in the period of 2005-2018.

Referring to the zinc reduction method reported by Xu et al.[18], a set of high vacuum pipelines for graphitization has been built as shown in Fig. S2. Firstly, dried organic powder which contains 2-3 mg C and 35-40 mg CuO powder is sealed in the quartz tube and burned at 0.1 Pa and 900°C for 7 hours. Secondly, the quartz tube is broken in a cracker, and the CO_2 flows into the pipelines. After the impurities have been removed and CO_2 metering, the CO_2 sample gas is captured in the reduction unit. The reduction unit is a set of glass tubes. The outer tube contains a mixed powder of 30-35 mg Zn and 10-15 mg TiH_2, which is used to generate H_2 and reduce CO_2 to CO. The inner tube contains 3-5 mg Fe powder, which is the catalyst for reducing CO to graphite. Finally, a torch fire is used to seal the sample CO_2 gas in the reduction unit. The graphitization reaction needs to be at 500°C for 3h then 550°C for 4h. More details can be found in Xu et al.[18].

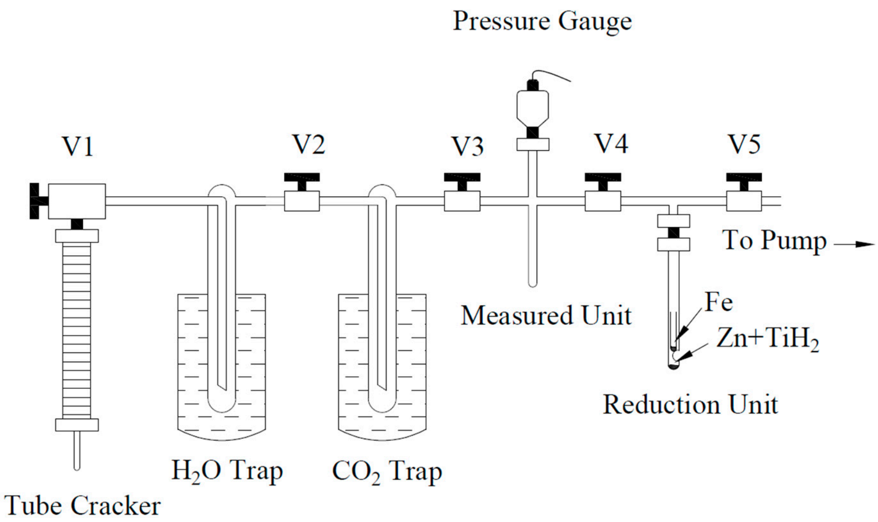


Figure S2. Graphitization system. H_2O trap cooled with ethanol at −65 °C; CO_2 trap cooled with liquid nitrogen; V1-V5: valves;.

2. Table Captions

Table S1. ^{14}C activity of sampled annual crops and tree rings.

Sample	Lab. Code	^{14}C activity [pMC]	Sample	Lab. Code	^{14}C activity [pMC]
SQ_A-R	XA50256	96.67±0.21	SQ-P_B	XA50251	99.22±0.32
SQ_B-R	XA50257	98.46±0.31	GG_A-R	XA50259	98.25±0.19
SQ_C-R	XA50258	98.89±0.21	GG_A-C	XA50261	98.95±0.21
SQ-P_{R1}	XA50246	101.74±0.19	GG_A-S	XA50263	98.73±0.20
SQ-P_{R4}	XA50247	101.67±0.32	GG-E_{R1}	XA50252	102.33±0.27
SQ-P_{R7}	XA50248	99.28±0.18	GG-E_{R4}	XA50253	100.20±0.19
SQ-P_{R10}	XA52049	98.75±0.19	GG-E_{R6}	XA50254	100.31±0.22
SQ-P_{R13}	XA50250	98.88±0.24	GG-E_B	XA50255	99.94±0.22