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Chemistry of Atmospheric Wet Deposition in Southern Iraq During Winter 2001 – 2002.

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Abstract

For the period of Dec. 2001– Jan. 2002, wet samples of rain water were collected from different sites covered the industrial sites of petrochemical company in southern Iraq. The samples were analysed for pH, conductivity, chloride, sulphate, calcium, magnesium, bicarbonate and phosphate concentrations. Lower pH recorded were 6.5 in the petrochemical company while maximum value recorded was 7.6 in the atmosphere of paper and mill company. For chloride lower value recorded was 35.45 mg/l in Shuaiba site and maximum value was 106.4 mg/l in Umm Qaseer. These values were accompanied with electric conductivity of 0.02 mS/cm in Shuaiba and maximum value of 0.72 mS/cm in Umm Qaseer . Calcium and magnesium ranged between 0.1-2 mg/l and 0.0 – 1.16 mg/l respectively. Sulphate ranged from 16.4 mg/l in petrochemical company to 11.93 mg/l in Basrah city. Bicarbonate was high and ranged between 61.0 mg/l in Shuaiba and 109.8 mg/l in Zubair town. For phosphate values were low and ranged from 0.50 μg at.P-PO_4^{3-} /l in Basrah city to 1.26 μg at.P-PO_4^{3-} /l in Petrochemical company. Wet precipitation in southern Iraq showed moderate values of pH with slight acidity due to industrial emissions of N and S, and slight basic due to the dust from the land of basic characteristics.

Key words: Rain fall, Chemistry of Depositions, Southern Iraq, Environmental Parameters.

Introduction

Possible emissions of atmospheric pollutants like SO and NO from industrial sources as well as domestic waste from cities, waste disposal centre's and traffic could be producing undesirable ecological changes at sites remote from their emission sources and even in other countries[1-3].

Pollutants in the atmosphere are removed by different processes which categorized gravitational; dry depositions and; wet depositions. Wet depositions due to rain or snow is the most effective cleaning process for gaseous and small particle pollutants in air[4].

Acid combination between rain and land may reduce the diversity and productivity of aquatic organisms when it reaches the water basin even if there were other factors affecting diversity and productivity[5].

Several studies of atmospheric deposition chemistry were made in Iraq in the 1990' with special attention to the acidity issue[6-10].

Wet deposition as rain is believed to be acidic in nature [11-13]. The acidifiers include sulphur compounds from sea salts, nitrogen oxides from soil exhalation, and chlorides while the principal basic substances are ammonia and soil dust [13,14].

Wet deposition chemistry in southern Iraq is characterized by high base-cation deposition because of the episodic transport of Saharan dust.

Experimental

Atmospheric inputs have historically been measured by open- bucket collectors which do not allow separation of wet vs. dry inputs [15]. Daily wet precipitation samples from different sites in southern Iraq, (Fig. 1), were collected, depending upon rain occasions, for the period of Dec. 2001 to Jan.2002 by the technique recommended by different sources

[16,17]. A clean all conventional polyethylene bowl open to atmosphere for total deposition was used for rainwater collection [17]. The bowl was put on a wooden table on the top of the building to avoid any contamination. One litter of wet precipitation was sampled and analysed in the water laboratory of Marine Science Centre by adopting standard methods [18]. Concentrations of the following basic parameters: chloride, sulphate, calcium, magnesium, bicarbonate, and phosphate as well as pH and Electric Conductivity (EC) were estimated within 12 hours from collection time. For chemical analyses, rainwater was transferred to polyethylene containers by using a funnel and kept in fridge after the addition of few drops of chloroform as a preservative. The pH was determined by a pH/mV meter fitted with combined glass and reference electrodes calibrated with dilute acid solution as a primary standard. EC in mS/cm was determined by conductivity meter. The collecting bowls and containers were cleaned by dilute HNO_3 and distilled water.

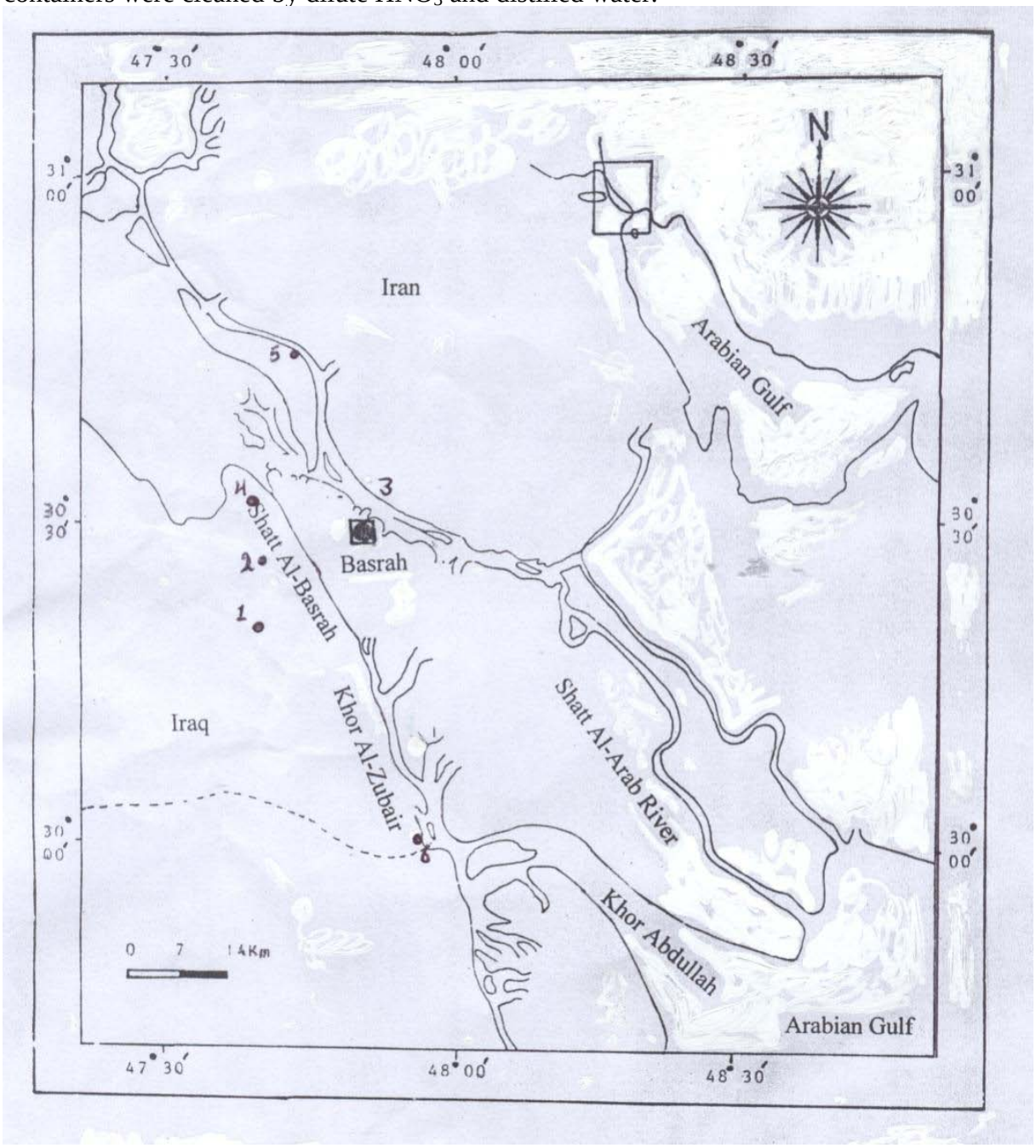


Figure 1. Map of southern Iraq showing the position of sampling stations.

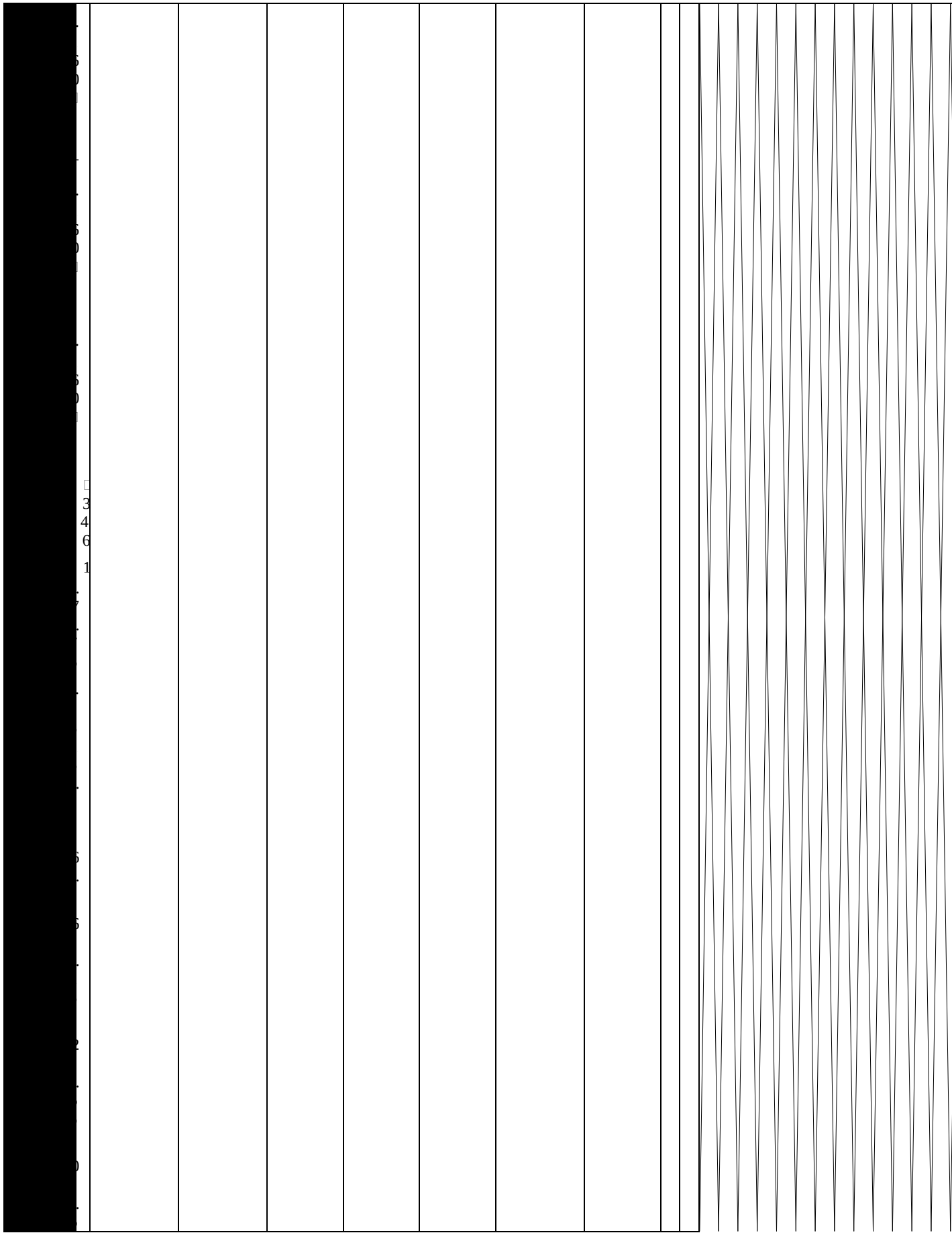
Results and Discussion

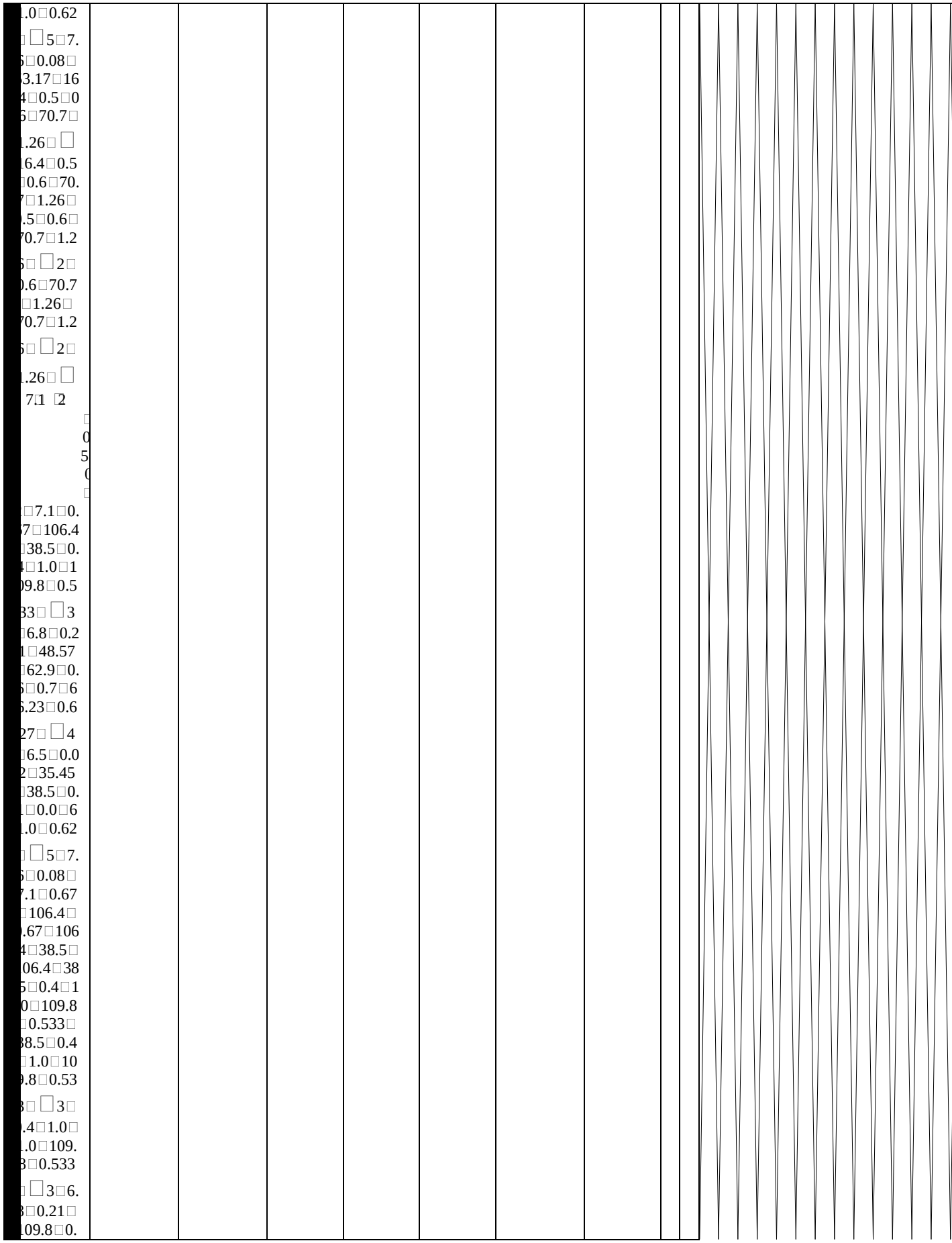
Wet deposition technique has been adopted for sampling in this study [16] for its simplicity with one difficulty in defining exactly when the precipitation starts and finishes.

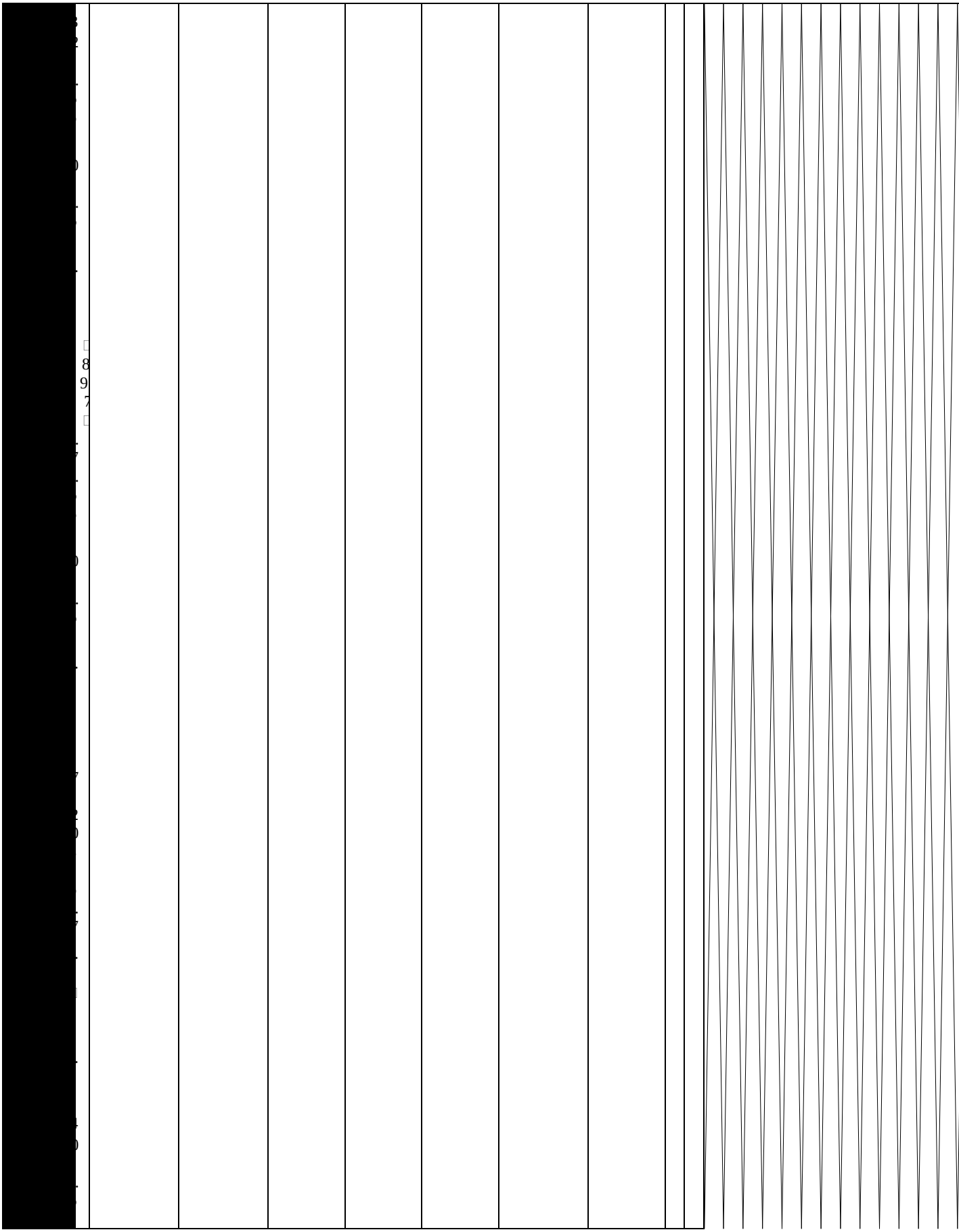
Due to the expected contamination from dry depositions of different origins, collecting bowls were not left on the roof of the building all the time which led to missing rain collection in certain events. The knowledge of the chemical composition of precipitation makes it possible to evaluate the degree of air pollution, the corrosiveness of atmospheric waters and the effect of precipitation on material balance of soils, water and vegetation. For the studied sites and along the period of the study, the chemical composition of the precipitation was homogenous. The variation of various occasions of wet precipitation during the period of investigation are given in tables 1 and 2. The pH of wet precipitation at southern Iraq has a mean value ranged between 6.5 and 7.6 close to those measured during the late nineties of the last century [9] and more acidic than those measured early nineties of the last century [6,20,7,19]. The range of pH values indicates that the studied sites are affected by the presence of pollutants from different sources [20].

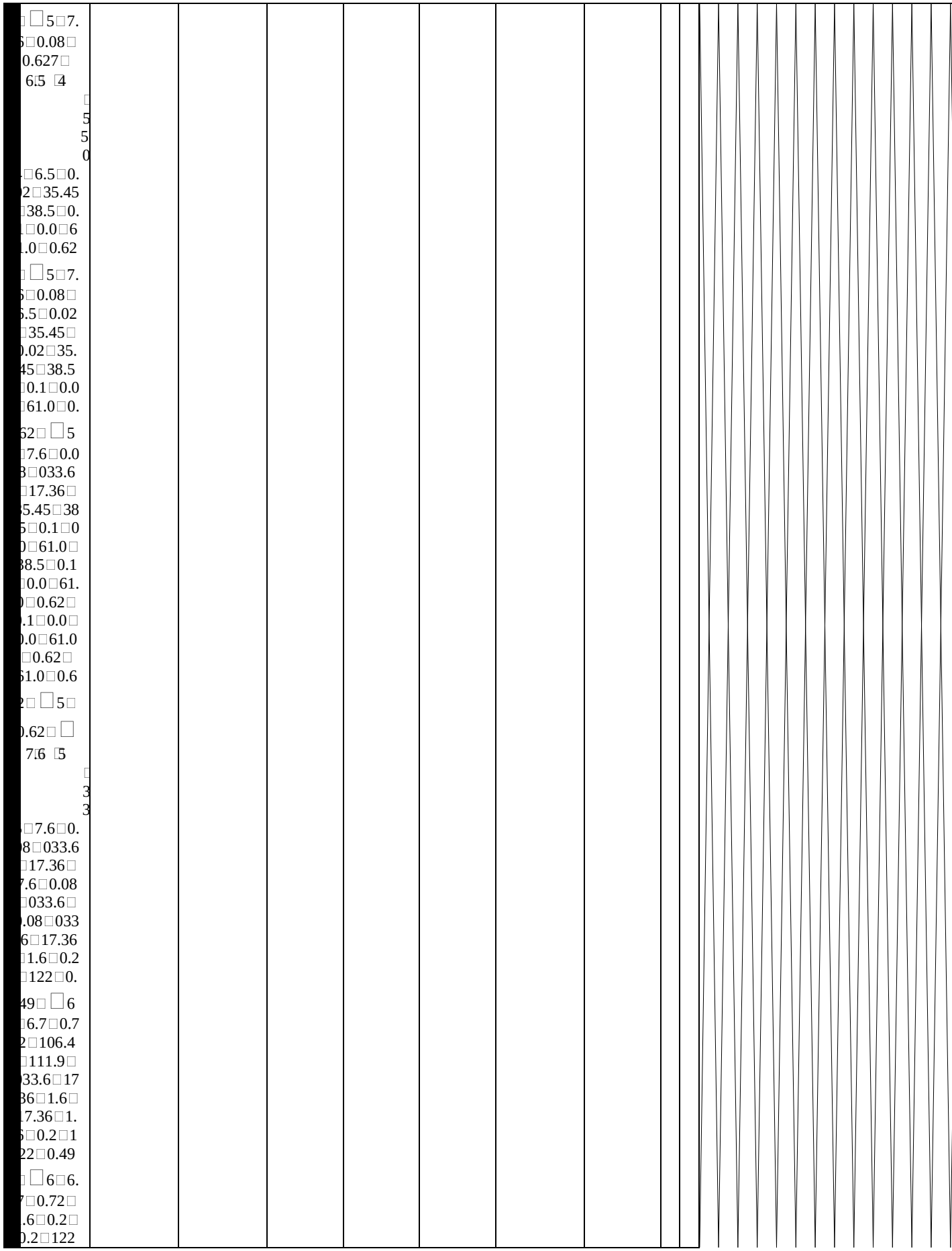
Table 1. Mean concentrations (in mg/l) for rainwater parameters at southern Iraq for the period Dec. 2001- Jan. 2002(pH without unites and EC in mS/cm).

Table 2. **Mean concentrations (in mg/l) for rainwater parameters at Basrah city for the period Dec. 2001-Jan. 2002(pH without unites and EC in mS/cm).**









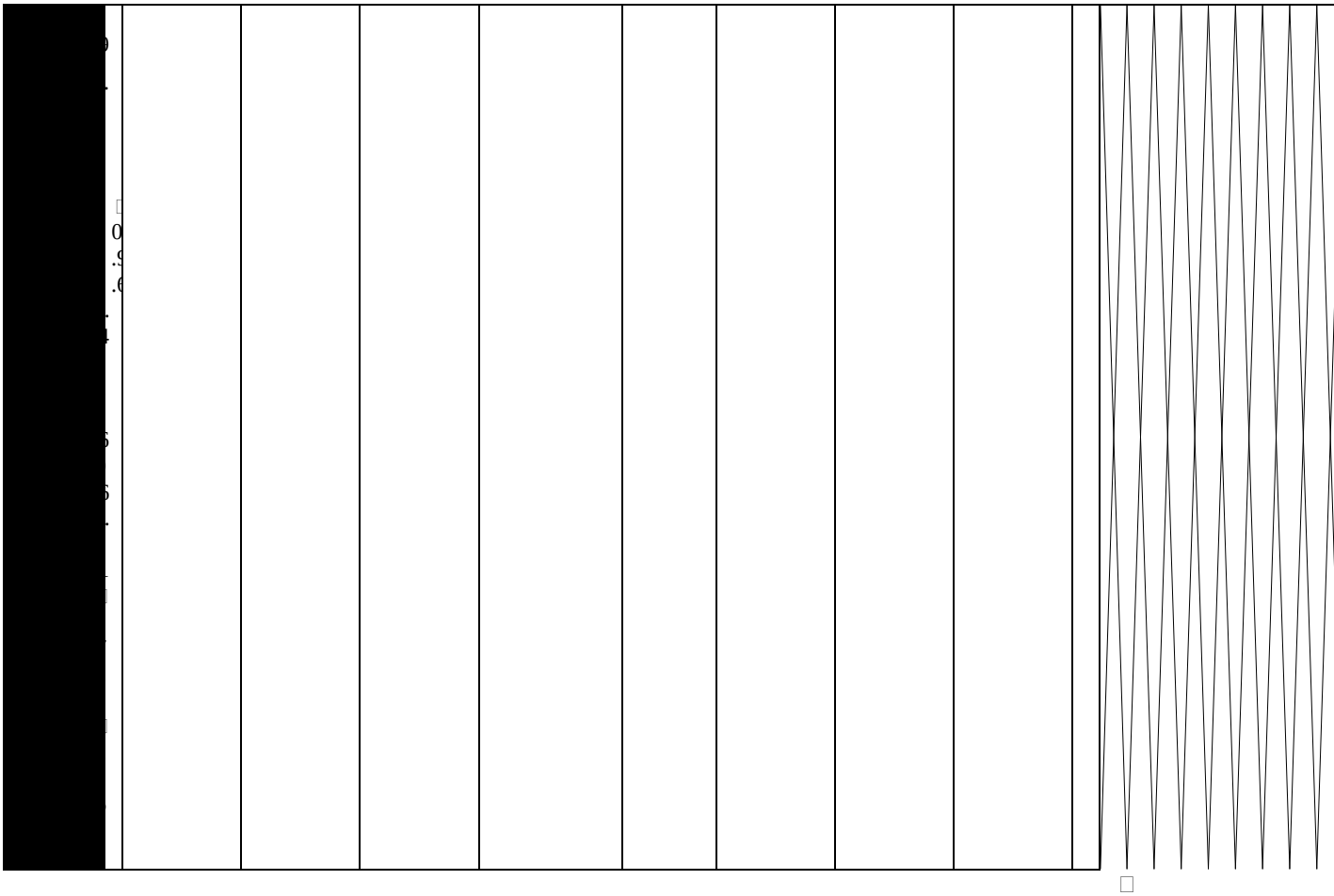


Table 2. **Mean concentrations (in mg/l) for rainwater parameters at Basrah city for the periodDec. 2001- Jan. 2002(pH without unites and EC in mS/cm).**

Site,position	PH	EC	Cl^-	$S\text{-}SO_4^{2-}$	Ca^{2+}	Mg^{2+}	HCO_3^-	$P\text{-}PO_4^{3-}$
Northren Basrah	6.7	0.01	51.87	40.64	0.63	1,16	77.3	0,50
Westren Basrah	7.1	1.03	70.9	111.93	2.0	0.4	122	0.83
Center of Basrah	6.8	0.15	39.02	73.33	0.1	0.3	79.3	0.68

Low pH values recorded in certain sites could arise from high concentrations of chloride and sulphate from sea source as in Umm Qasser (st. 6) or lower values of the basic cation's calcium and magnesium from soil dust as in Shaibah (St. 4). Wet precipitation with pH higher than 6 could arise from the transport of alkaline dust [21].

Conductivity of rain water was lower at Basrah city and sites to the north and south of Basrah city, while other sites (St. 1, 2, and 6) showed moderate conductivity of the rain due to the effect of industrial emissions and sea spray [22].

Chloride in the rain has two main sources; sea spray and industrial emissions [22]. The dominant source of chloride in the rainfall at Basrah city could be related to the industrial emission while the dominant source in the rainfall at southern Basrah city seems to be the sea spray from the Arabian Gulf. The high value recorded is in Umm Qaseer (st. 6) which is located on the northern site of the Arabian Gulf.

Owing to their similar chemical behaviour, particularly their neutralizing ability, calcium and magnesium are usually considered together [22]. Their concentrations appear to fluctuate from one site to another mainly due to soil dust as a source in arid and semiarid land [14].

For rain water fallen at Basrah City, calcium and magnesium range between 0.1-2 and 0.3-1.16 mg/l respectively as shown in table 2.

Bicarbonates are the higher in concentrations in the rainwater with no predomination from sea spray or industrial emission sources.

Phosphates are measured as soluble reactive phosphorus predominantly PO_4^{3-} ions with low levels independent of location.

Correlation between measured parameters for bulk rain samples in the studied sites are listed in table 3, it shows a good agreement for pH with chloride(r=0.920) and bicarbonate (r=0.931) and calcium (r=0.751), and EC with magnesium (r= 0.773) and chloride with calcium(r=0.895) and bicarbonate (r=0.876), while moderate correlation for EC with sulphate (r= 0.377), calcium(r=0.222) and phosphate(r=0.316), and calcium with bicarbonate(r=0.616). Other correlations are low or negative.

Table 3. Correlation coefficients between the studied environmental parameters in rain waterfallen at southern Iraq.

	pH	EC	Cl^-	$S\text{-}SO_4^{2-}$	Ca^{2+}	Mg^{2+}	HCO_3^-
EC	**- 0.210**						
Cl^-	**0.920**	**- 0.117**					
$S\text{-}SO_4^{2-}$	**- 0.656**	**0.018**	**-0.184**				
Ca^{2+}	**0.751**	**0.222**	**0.895**	**0.050**			
Mg^{2+}	**0.017**	**0.773**	**-0.099**	**0.239**	**-0.138**		
HCO_3^-	**0.931**	**0.026**	**0.876**	**-0.377**	**0.616**	**0.153**	
$P\text{-}PO_4^{3-}$	**- 0.584**	**0.317**	**-0.452**	**-0.297**	**-0.291**	**0.095**	**-0.435**

The three main factors influencing precipitation chemistry are anthropogenic air pollution; mineral dust and sea spray [21]. The high concentration of chloride shows the high influence of sea spray (sea salt). Alkaline dust, transported from the Sahara, is relatively frequent in the atmospheric precipitation and influences mostly the calcium and magnesium concentrations exerting a buffering action on the acidity of the depositions. Sulphate is generally linked with air pollution [21].

Conclusion

In cleaner areas, the pH of precipitation water is 5.6 as a result of dynamic equilibrium between CO_2 concentration in water and in air. By solution of nitrogen and sulphur in precipitation water the pH markedly declines. The deposition at southern Iraq does not represent acidic character but neutral to slightly acidic.

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كيميائية المتساقطات الجوية الرطبة في جنوب العراق شتاء 2001 – 2002

وصال فخري حسن وأمال احمد محمود و فارس جاسم محمد الأمارة

فزلطكقيليئ؟ هلكمتطكطيئ بطكاحفيب, لنقر عكطكاحئذ, جئلعبطكا شنب

طكا شنب –طكحف

طكخلاصدب

للفترة كانون الأول 2001- يناث نوناك 2002 تم جمع عينات مياه متساقطات رطبة من عدة مواقع جنوب العراق, تم تحليلها لقياس كل من الآس الهيدروجيني والتوصيلية الكهربائية وتراكيز الكلوريد والكبريتات والكالسيوم والمغنيسيوم والبكاربونات والفوسفات. وغطت الدراسة موقع الصناعات البتروكيمياوية في خور الزبير. ادنى اس هيدروجيني تم تسجيله كان بحدود 6.5 في مجمع البتروكيمياويات واعلى قيمة سجلت 7.6 في موقع الصناعات الورقية. وللكلوريد كانت ادنى قيمة 35.45 ملغم\لتر في الشعيبة واعلى قيمة 106.4 ملغم\لتر في موقع ام قصر ورافقت هذه القيم توصيلية كهربائية دنيا 0.02 ملي سيمنز\سم في الشعيبة وقيمة عليا 0.72 ملي سيمنز\سم في ام قصر. وتراوحت قيم الكالسيوم والمغنيسيوم بحدود 0.1 – 2 و 0 – 1.16 ملغم\لتر على التوالي وكانت الكبريتات بين 16.4 ملغم\لتر في مجمع البتروكيمياويات و 111.93 ملغم\لتر في مركز مدينة البصرة , وكانت البيكاربونات عالية وتراوحت بين 61 ملغم\لتر في الشعيبة و 109.8 ملغم\لتر في مدينة الزبير. اما قيم الفوسفات فقد كانت واطئة وتراوحت بين 0.50 و 1.26 مايكروغرام ذرة فوسفور_فوسفات\لتر في كل من مدينة البصرة ومجمع البتروكيمياويات على التوالي. اظهرت المتساقطات الرطبة في جنوب العراق قيم معتدلة للآس الهيدروجيني تميل نحو الحامضية بسبب المنبعثات الصناعية.

كلمات دالة: امطار, كيميائية المتساقطات, جنوب العراق, محددات بيئية.