Determination of Elemental Concentration in Drinking Water from Various Townships of Yangon

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ABSTRACT

- The natural drinking water samples, from the six different townships in Yangon, were analyzed by the Atomic Absorption Spectroscopy.
- These samples were collected from some tube-wells and lakes. The concentration of some useful elements and toxic elements for human's health are determined.
- The concentration of the observed elements were found to be within the acceptable levels.

INTRODUCTION

- Water is a natural resource, essential for agriculture, industry and even human existence.
- Water that is to be used for drinking should not contain chemicals or micro-organism that could be hazardous to health.
- Similarly, water for agricultural irrigation should have a low sodium content, while that used for steam generation and related industrial uses should be low in certain other inorganic chemicals.

- Any particular use will have certain requirements for the physical, chemical or biological characteristics of wastes, for example limits on the concentrations of toxic substances for drinking water use, or restriction on temperature and pH ranges for water supporting invertebrate communities.

- Direct contamination of surface waters with metals in discharge from mining, smelling and industrial manufacturing is a long-standing phenomenon.

- However, the emission of airborne metallic pollutants has now reached such proportions that long-range atmospheric transport causes contamination.
- Not only in the vicinity of industrialized regions, but also in more remote areas.

- Similarly, moisture in the atmosphere combines with some of the gases produced when fossil fuels are burned and falling as acid rain, causes acidifications of surface water, especially lakes.

-Contamination of water by synthetic organic micro pollutants results either from direct discharge into surface water or after transport through the atmosphere.

- Today, there is trace contamination not only of surface water but also of ground water bodies, which are susceptible to leaching from waste dumps, mine tailings and industrial production sites.

- It is important to note the emphasis given to collection of data for a purpose of analyzing the various kinds of water, especially drinking water.

- Among the physical measurements of water such as water temperature, pH, conductivity, light penetration, flow velocity particle size of suspended and deposited material, the elemental composition of the water is great importance to human’s life.

- Atomic absorption spectrophotometry is commonly used in many analytical laboratories for determination of trace elements in water samples and in acid digests of sediments or biological tissues.
- It is a well-established method for trace element analyses of different kinds of samples because it can detect much lower levels (down to ppb) of concentration of the toxic elements can be detected.
- Therefore, in the present work, it is used to analyses twenty water samples in Yangon Region.

AAS AND EXPERIMENTAL TECHNIQUES

- Atomic Absorption Spectrometry is an analytical technique which has been developed primarily for determining metals at low concentration levels.
- AAS is highly sensitive for a wide range of elements including many which are difficult or impossible to analyze by flame photometry. It is rapid, specific, and need only a small amount of analyte.
- This method is especially suitable for analysis of micro components of trace elements. The photograph of the AA Analyst 800 spectrometer was shown in Figure 1.

Figure 1 The photograph of the Perkin Elmer Analyst 800 Atomic Absorption Spectrometer

Collection of Water Samples and Sample Prepration

- The specific places from which the water samples were collected in each township were shown in Fig 2.
- The places were chosen because they are crowded area in respective township.
- The water samples were collected from tube-wells or lakes at three different places in each township except Yangon downtown area which is wider than the townships.
- Five samples from different places were collected.

Figure 2 Map of Yangon Region (NGD, SDG, SPT, HL and MGLD)

- The samples of NGD1, NGD2, NGD3, SPT2, HL1, MGLD1, MGLD3, SDG1, SDG2 and SDG3 are tube well waters and each was collected via the tap.
- Similarly, YC1, YC3 and YC5 were lake waters (from Gyoe Phyu Lake), and were collected from the tap.
- The remaining were lake water samples which were obtained from about 15 ft depth, assuming that it is the middle of the depth of lakes.
- It is thought that the middle part of the lake water is clean from the environmental contamination such as algae and similar other organisms grown on the surface.

- Each collected water samples from respective tube-well and lake was immediately stored in separate air tight narrow necked glass bottle.
- All the bottles were stored in a refrigerator at 4ºC prior to any investigation.
- Sample preparation was performed by the automatic sampling system of AA Analyst 800 with PC control. As a result, it can be reduced sample preparation and analysis time and potential for contamination.

Results and Discussions

- In the present work, elemental compositions of each water samples from difference townships in Yangon Area were measured by using Atomic Absorption Spectrometry.
- Guideline in Drinking Water by the World Health Organization (WHO) is shown in table 1.
- Trace elements are inorganic elements (mostly metal).
- They are broadly classified, on the basis of their effect in living things, into three classes as follows;

(i) The essential nutritive elements such as Ca, Cu, Fe, I, Mn and Zn.

(ii)The non-nutritive and non-toxic elements such as Al, B, Cr, Ni and Sn.

(iii)The non-nutritive and toxic elements such as As, Sb, Cd, Pb and Se.

Table 1 Guideline in Drinking Water by the World Health Organization (WHO)

No	Element	Maximum acceptable concentration (WHO)
1	Magnesium (Mg)	50mg/l
2	Calcium (Ca)	50mg/l
3	Chromium (Cr)	0.05mg/l
4	Manganese (Mn)	0.4mg/l
5	Iron(Fe)	0.3mg/l
6	Copper (Cu)	2.0mg/l
7	Zinc (Zn)	5mg/l
8	Arsenic (As)	0.01mg/l
9	Cadmium (Cd)	0.003mg/l
10	Lead (Pb)	0.01mg/l

Table 2 Concentrations of elements in Tube Well Water Samples

Samples	As (μgL^{-1})	Pb (mgL^{-1})	Fe (mgL^{-1})	Zn (mgL^{-1})	Cd (mgL^{-1})	Na (mgL^{-1})	K (mgL^{-1})	Ca (mgL^{-1})
NGD-2	1.05	0.0241	0.070	ND	ND	29	2.6	90
NGD-3	1.23	0.0279	0.0215	ND	ND	26	6.0	110
SPT-2	0.98	0.0466	0.012	ND	ND	50	3.6	30
HL-1	0.02	0.0509	0.017	ND	ND	46	8.0	190
MGLD-1	ND	0.0498	0.005	ND	ND	0.7	0.5	10
MGLD-3	ND	0.0538	0.012	ND	ND	2.2	0.75	15
SDG-1	1.09	0.0635	1.118	ND	ND	24	5.9	120
SDG-2	1.05	0.0613	0.219	ND	ND	18	6.5	120
SDG-3	1.03	0.066	0.150	ND	ND	45	8.0	200

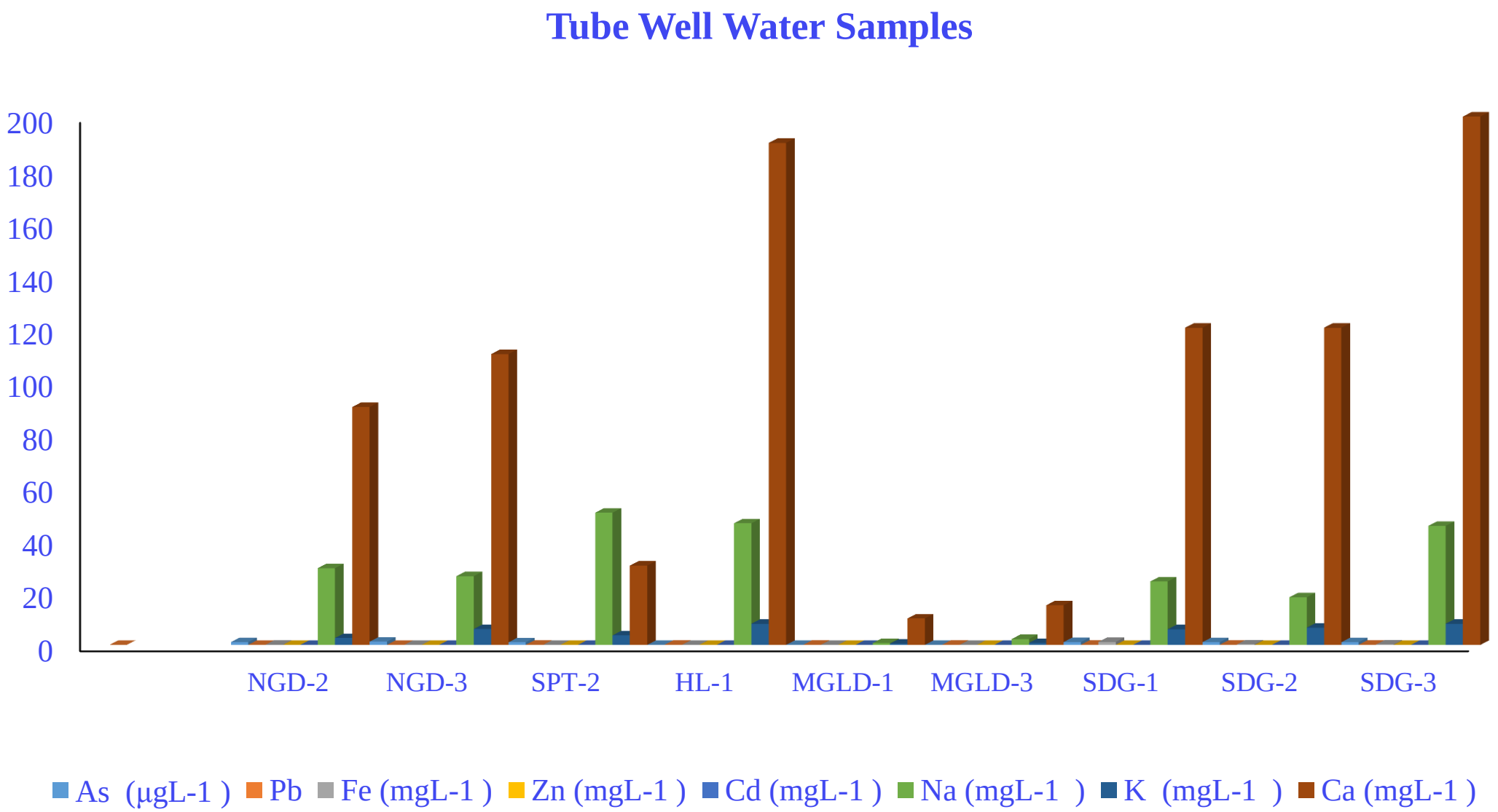

Figure 3 Comparisons of concentrations of each element in tube well water, natural lakes water and tap water

Table 3 Concentrations of elements in Lake Water Samples

Samples	As (μgL^{-1})	Pb (mgL^{-1})	Fe (mgL^{-1})	Zn (mgL^{-1})	Cd (mgL^{-1})	Na (mgL^{-1})	K (mgL^{-1})	Ca (mgL^{-1})
NGD-1	1.96	0.0187	1.596	ND	ND	10	2.1	42
SPT-1	1.66	0.0507	0.115	ND	ND	2.3	2.0	35
SPT-3	0.95	0.0494	0.127	ND	ND	2.8	1.2	24
HL-2	0.05	0.0493	0.176	ND	ND	27	3.0	58
HL3	0.07	0.0448	0.118	ND	ND	9.0	1.7	35
MGLD-2	ND	0.0567	0.045	ND	ND	5.0	1.3	27
YC-3	ND	0.0645	0.093	ND	ND	2.5	0.75	17
YC-1	ND	0.0614	0.028	ND	ND	5.2	2.1	43
YC-4	ND	0.0628	0.026	ND	ND	2.3	0.8	17
YC-2	ND	0.066	0.078	ND	ND	7.0	3.1	70
YC-5	ND	0.0691	0.063	ND	ND	2.4	0.8	17

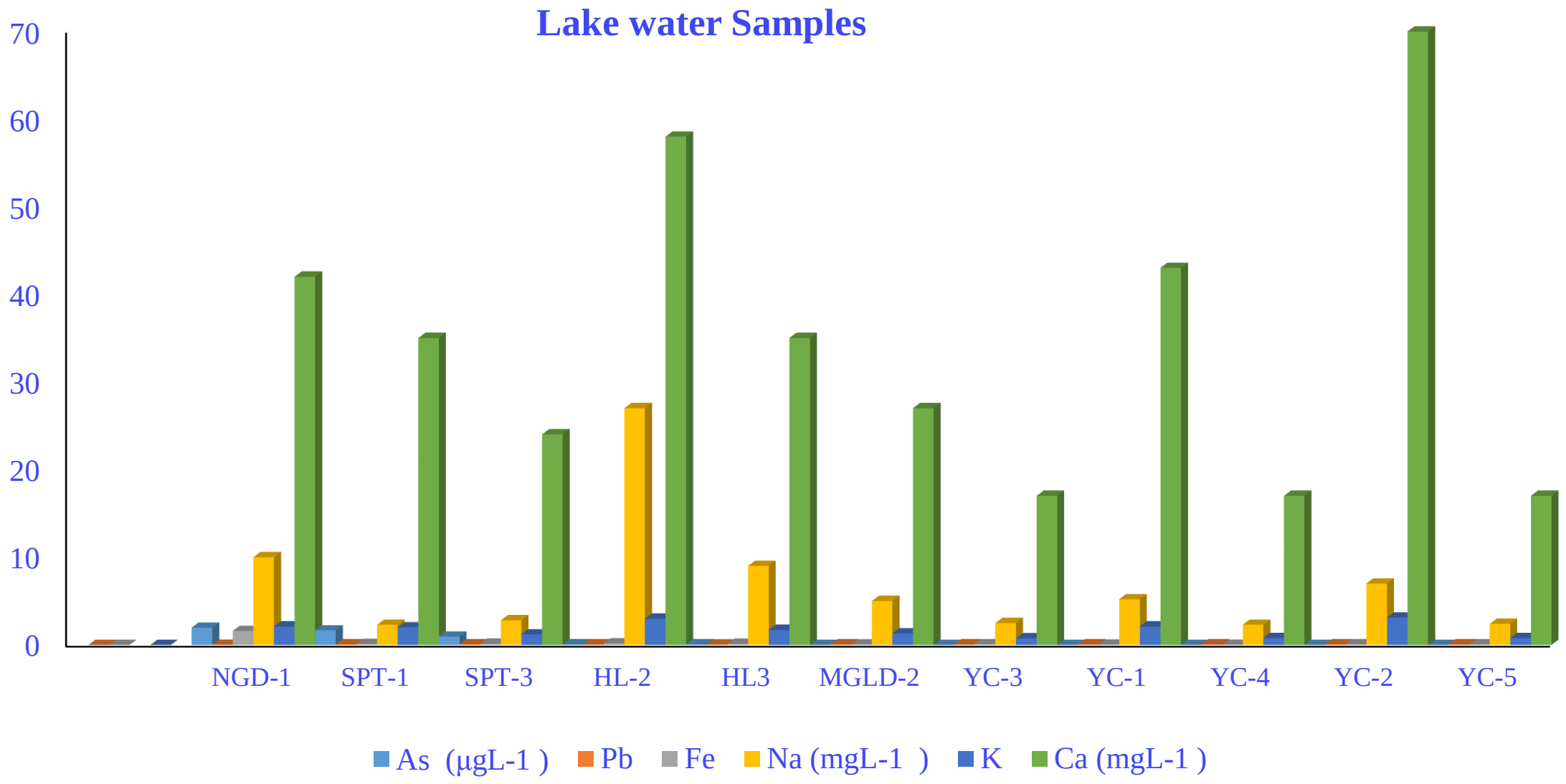

Figure 4 Comparisons of concentrations of each element in lakes water samples

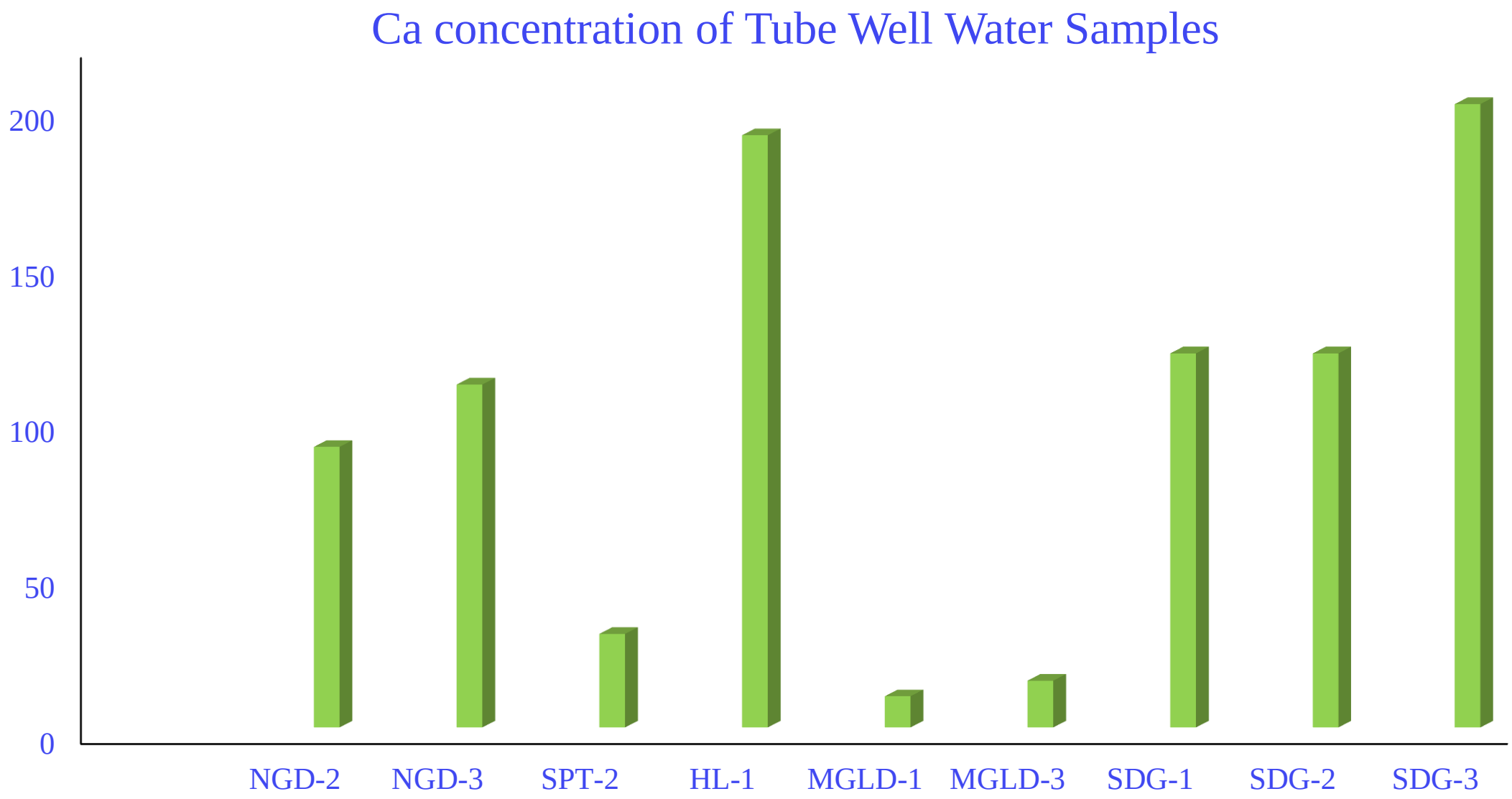

Figure 5 Ca Concentration of Tube Well Water Samples

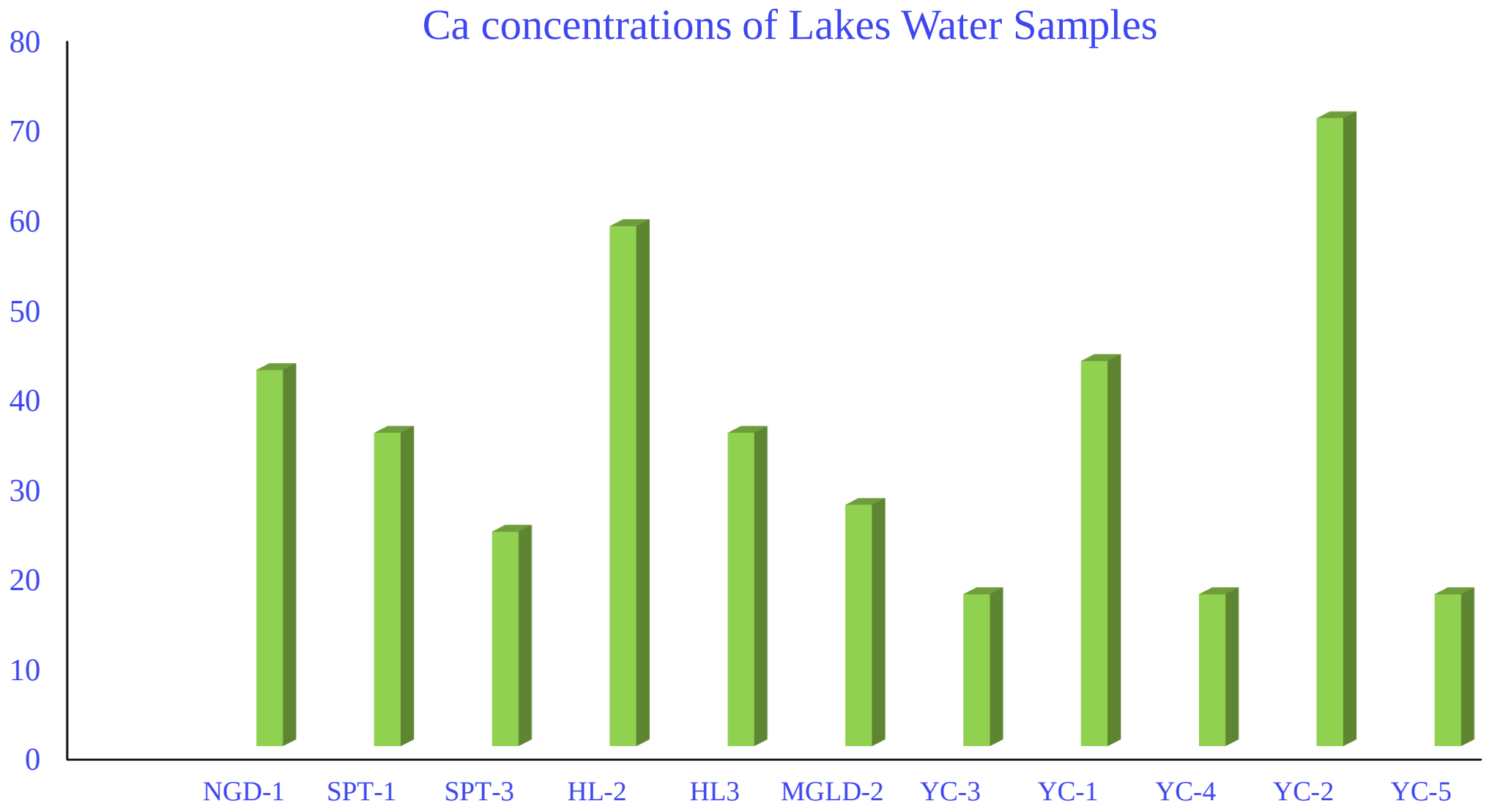

Figure 6 Ca Concentration of Lakes Water Samples

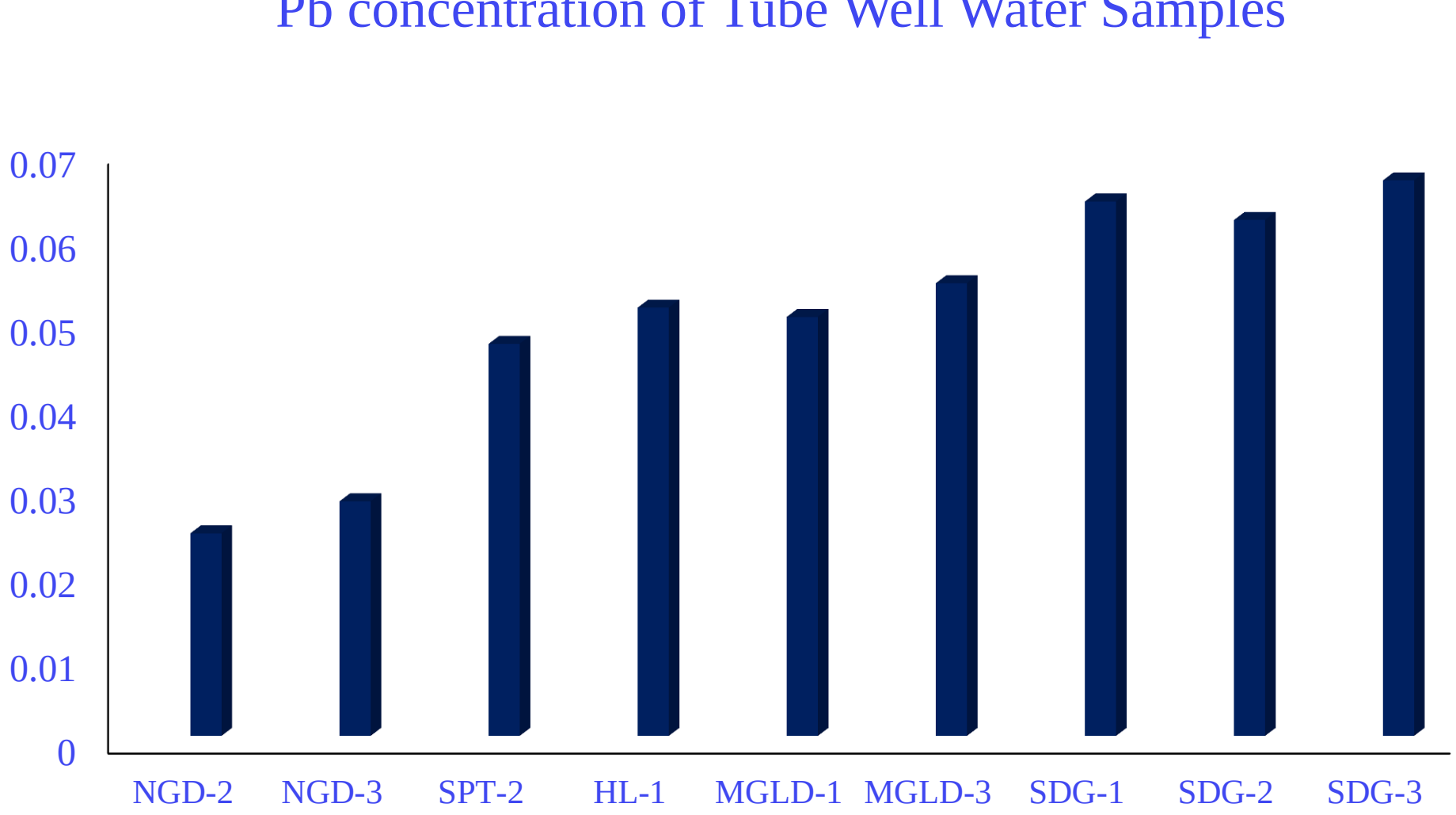

Figure7 Pb concentration of Tube Well Water Samples

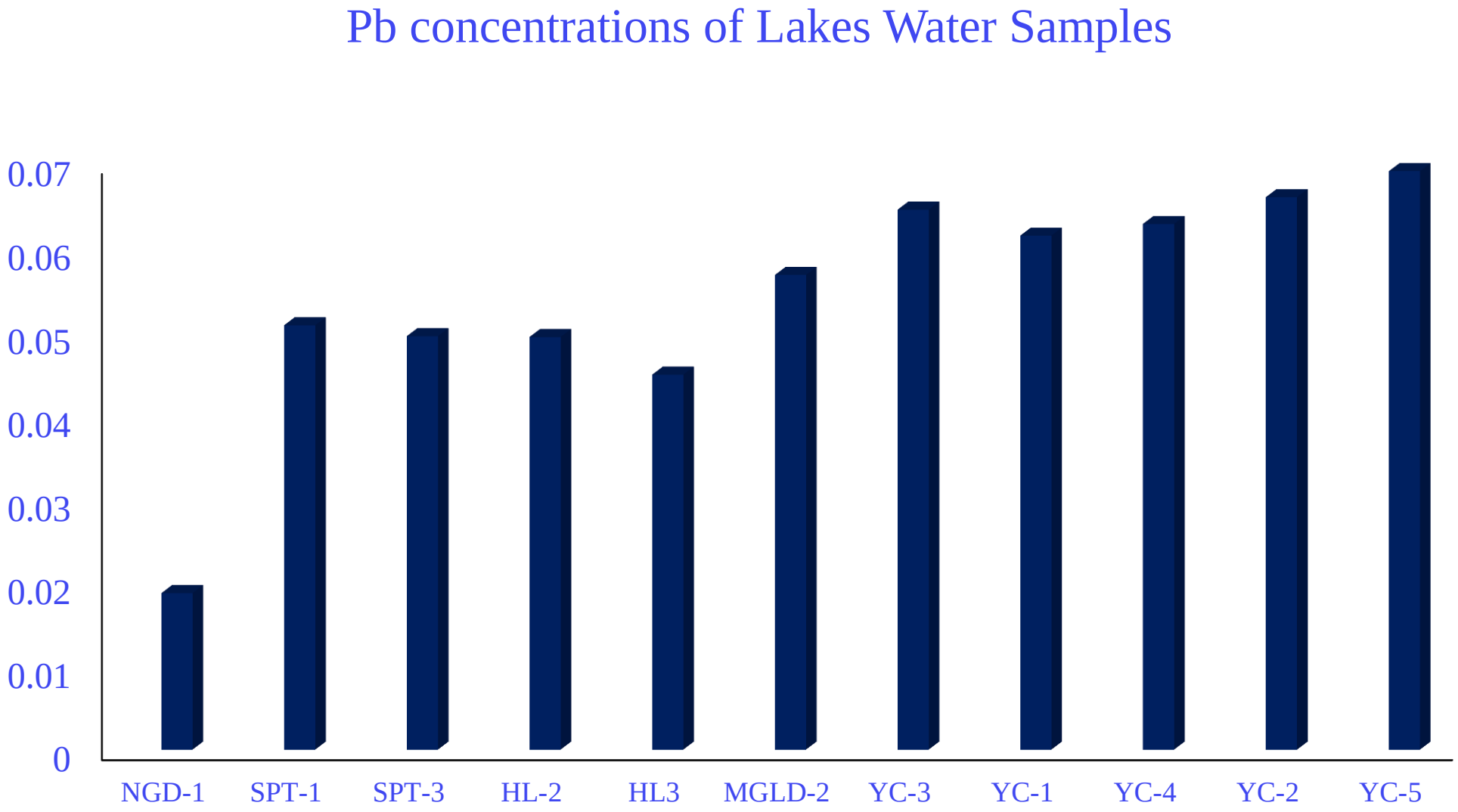

Figure 8 Pb concentration of Lakes Water Samples

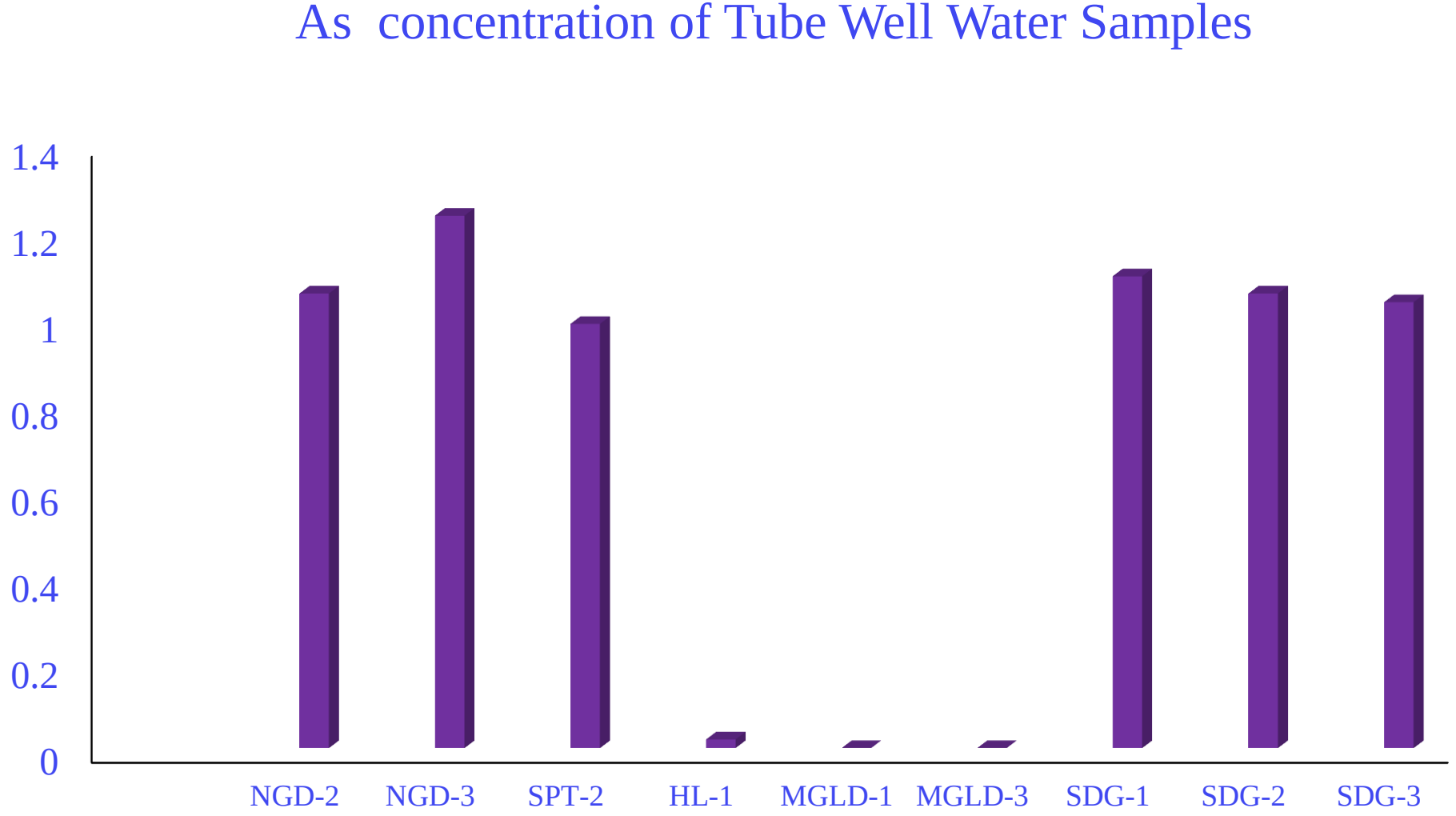

Figure 9 As concentration of Tube Well Water Samples

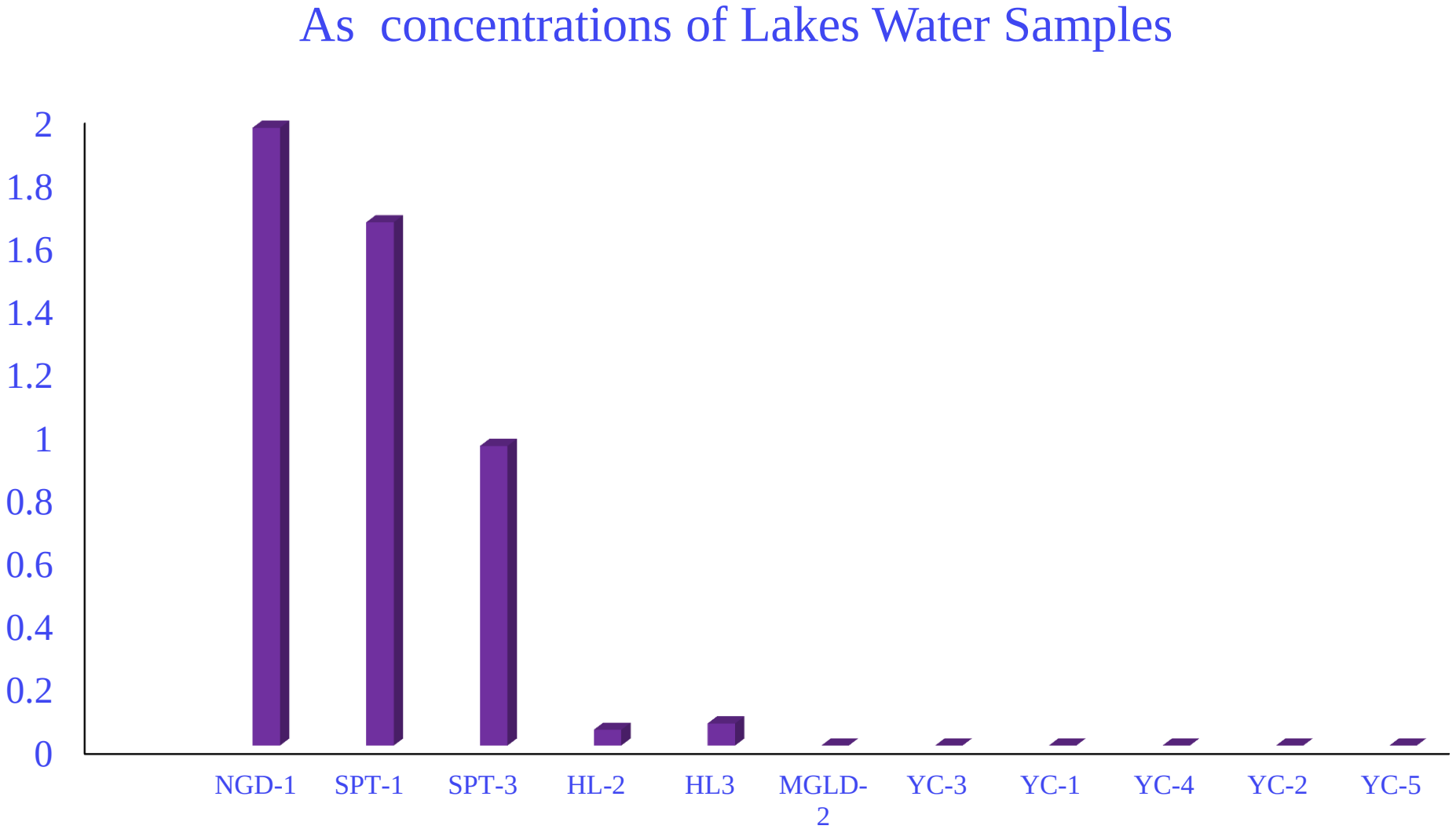

Figure 10 As concentration of Lakes Water Samples

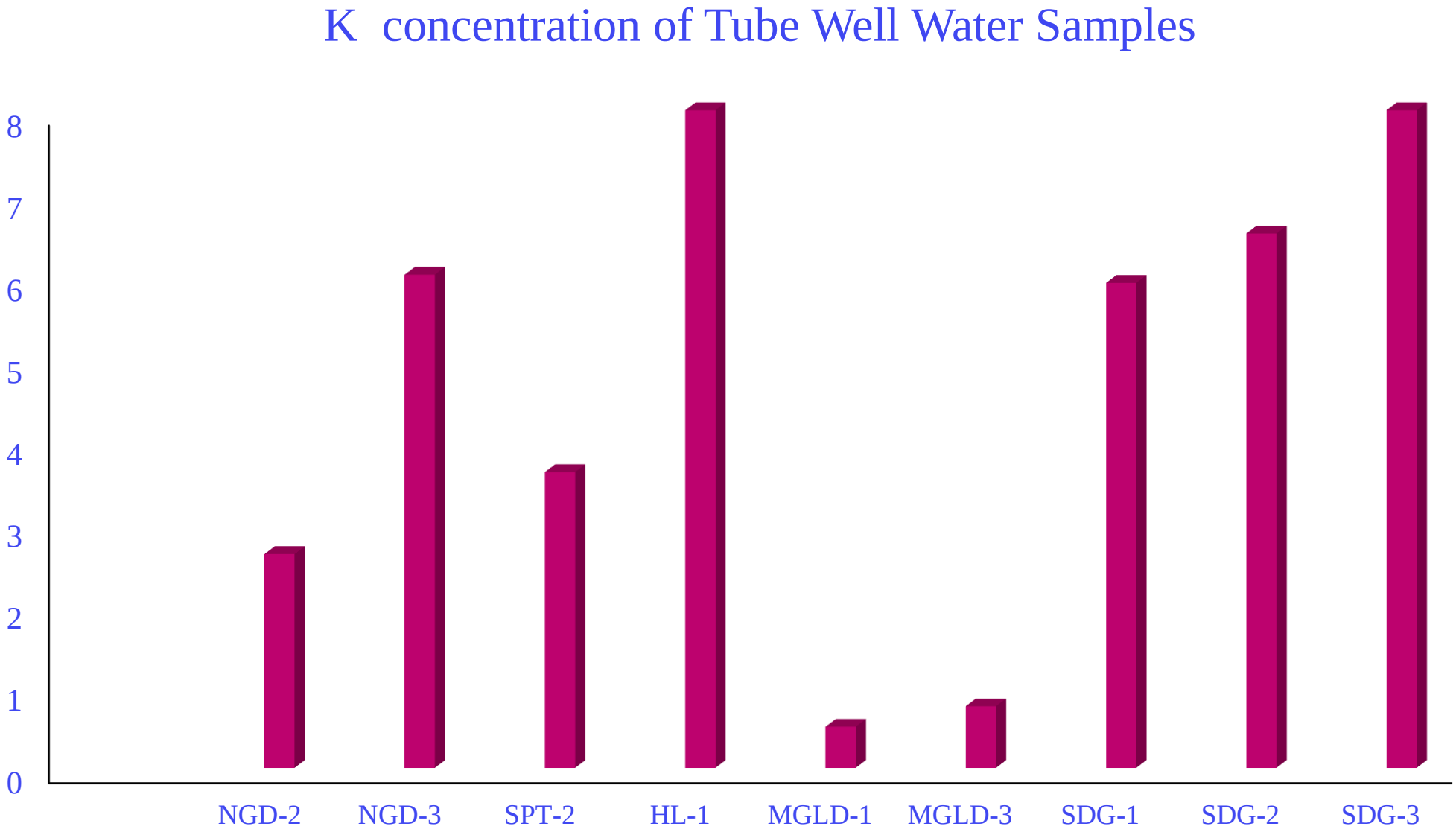

Figure 11 K concentration of Tube Well Water Samples

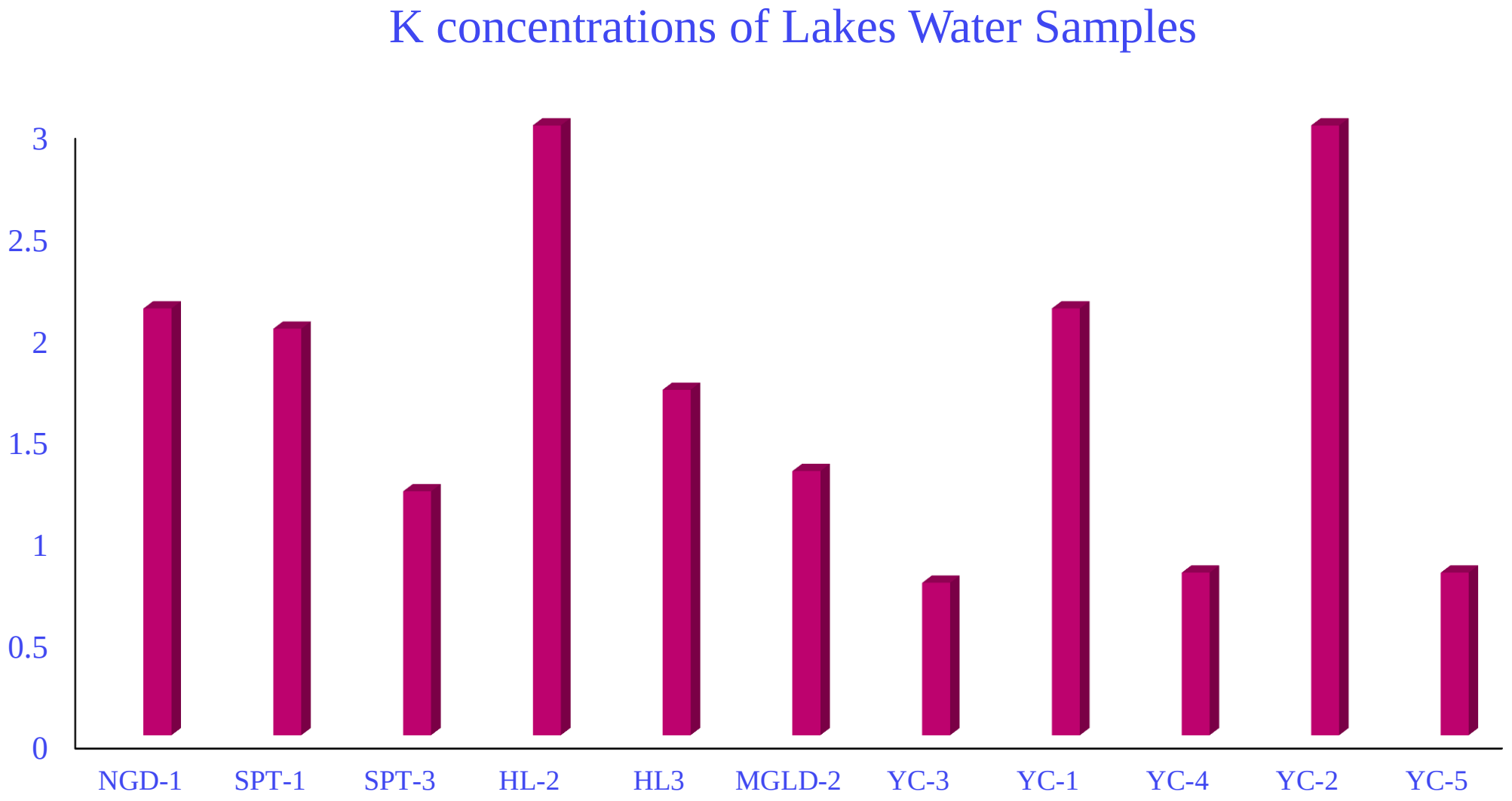

Figure 12 K concentration of Lakes Water Samples

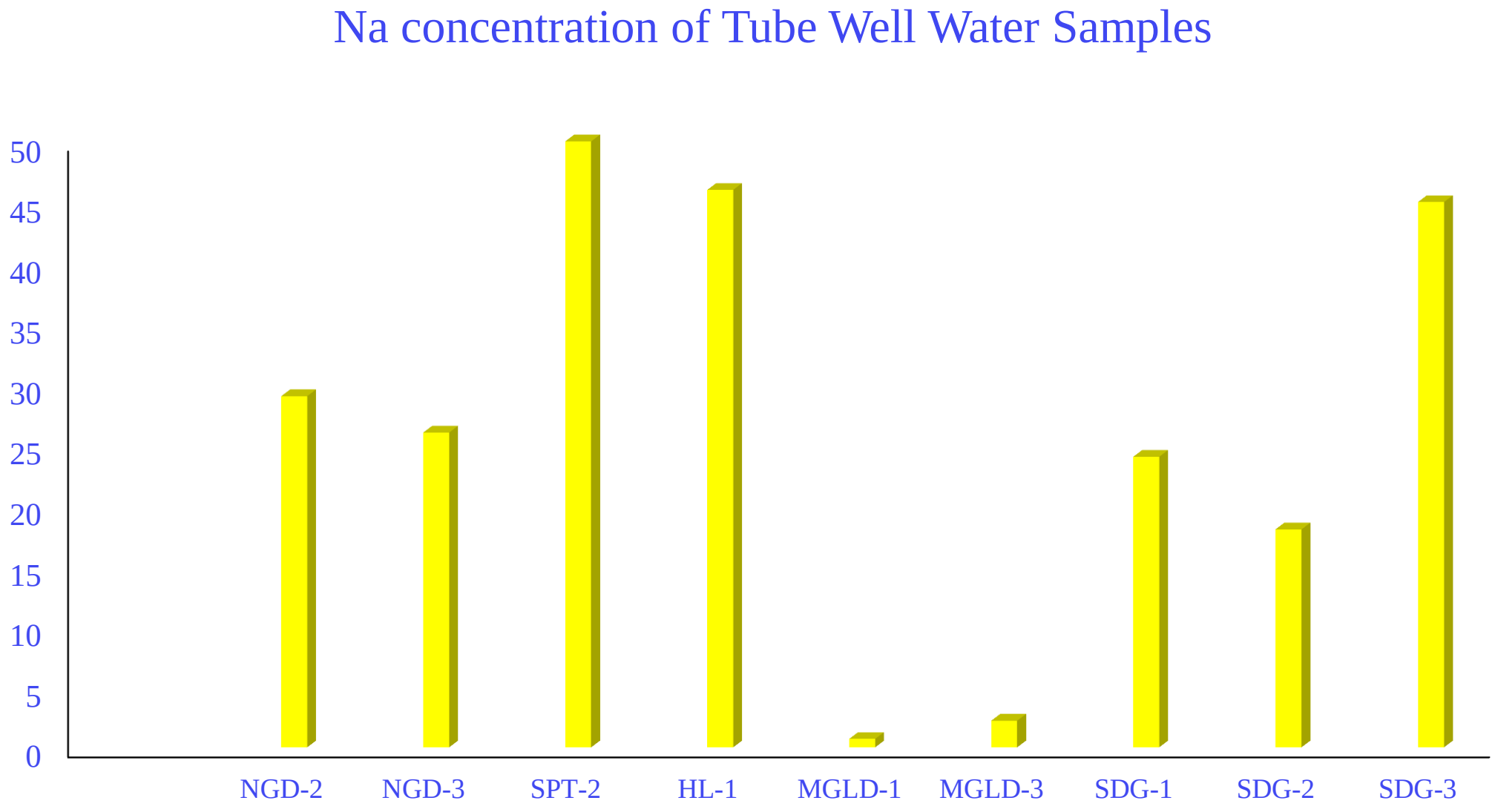

Figure 13 Na concentration of Tube Well Water Samples

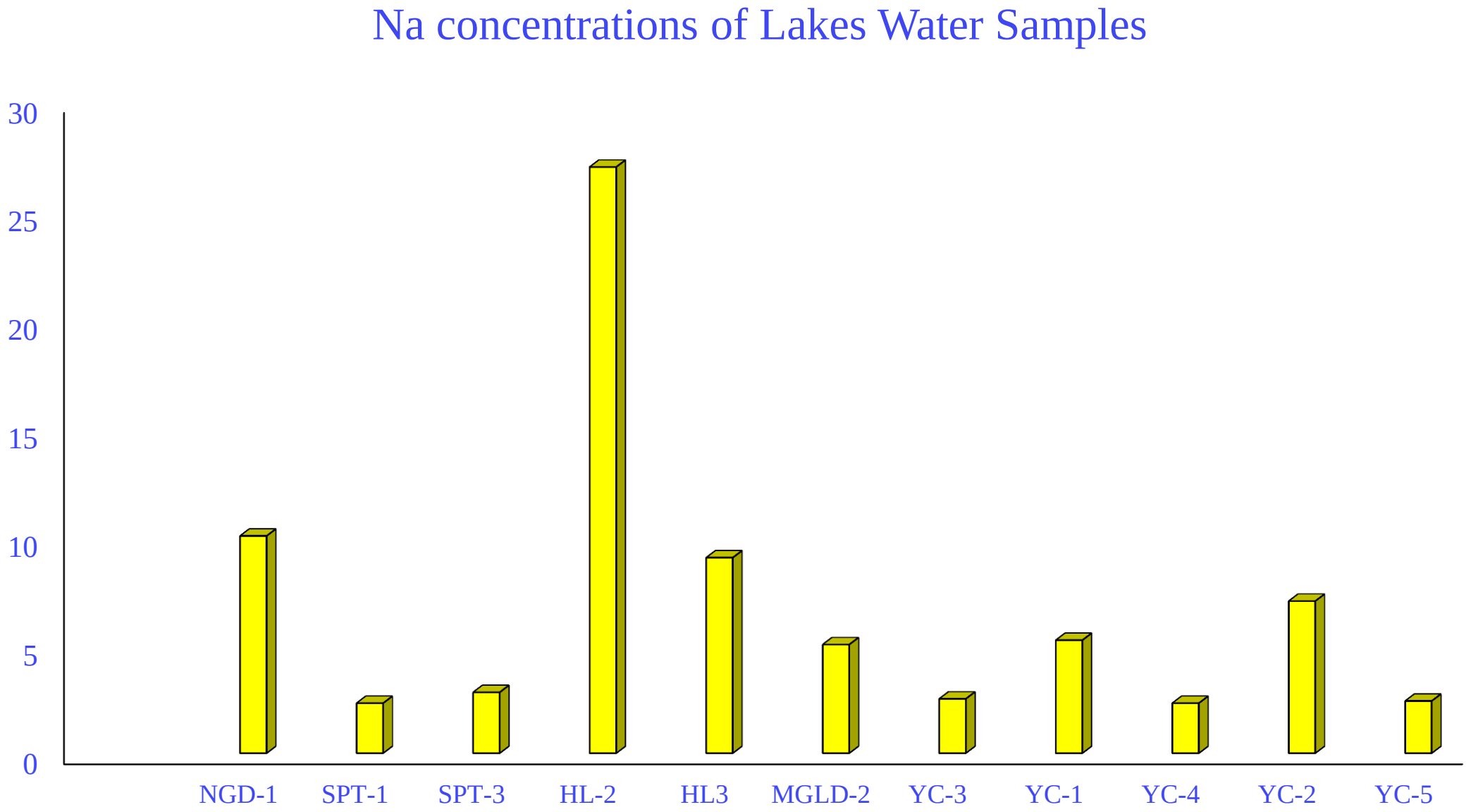

Figure 14 Na concentration of Lakes Water Samples

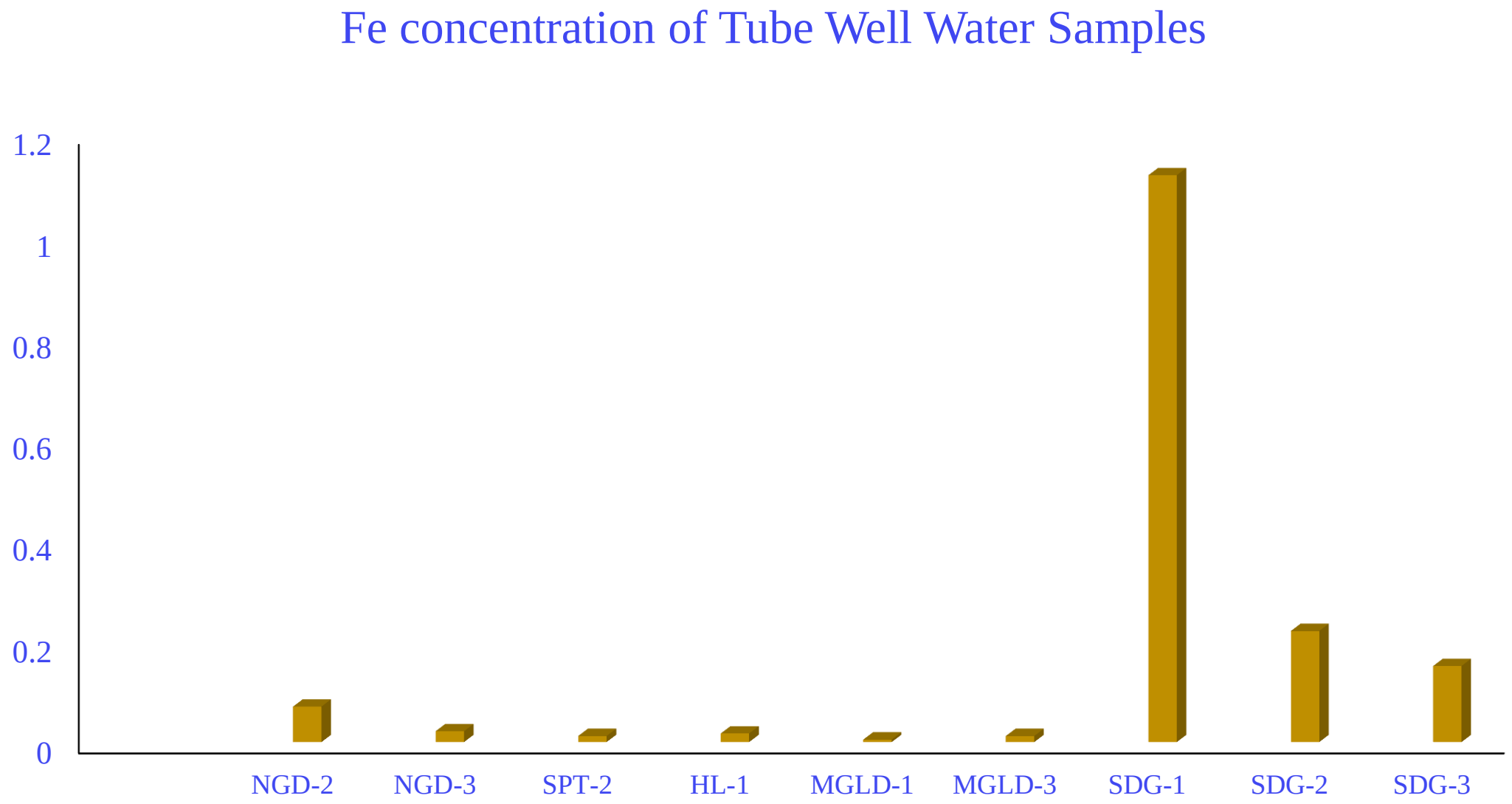

Figure 15 Fe Concentration of Tube Well Water Samples

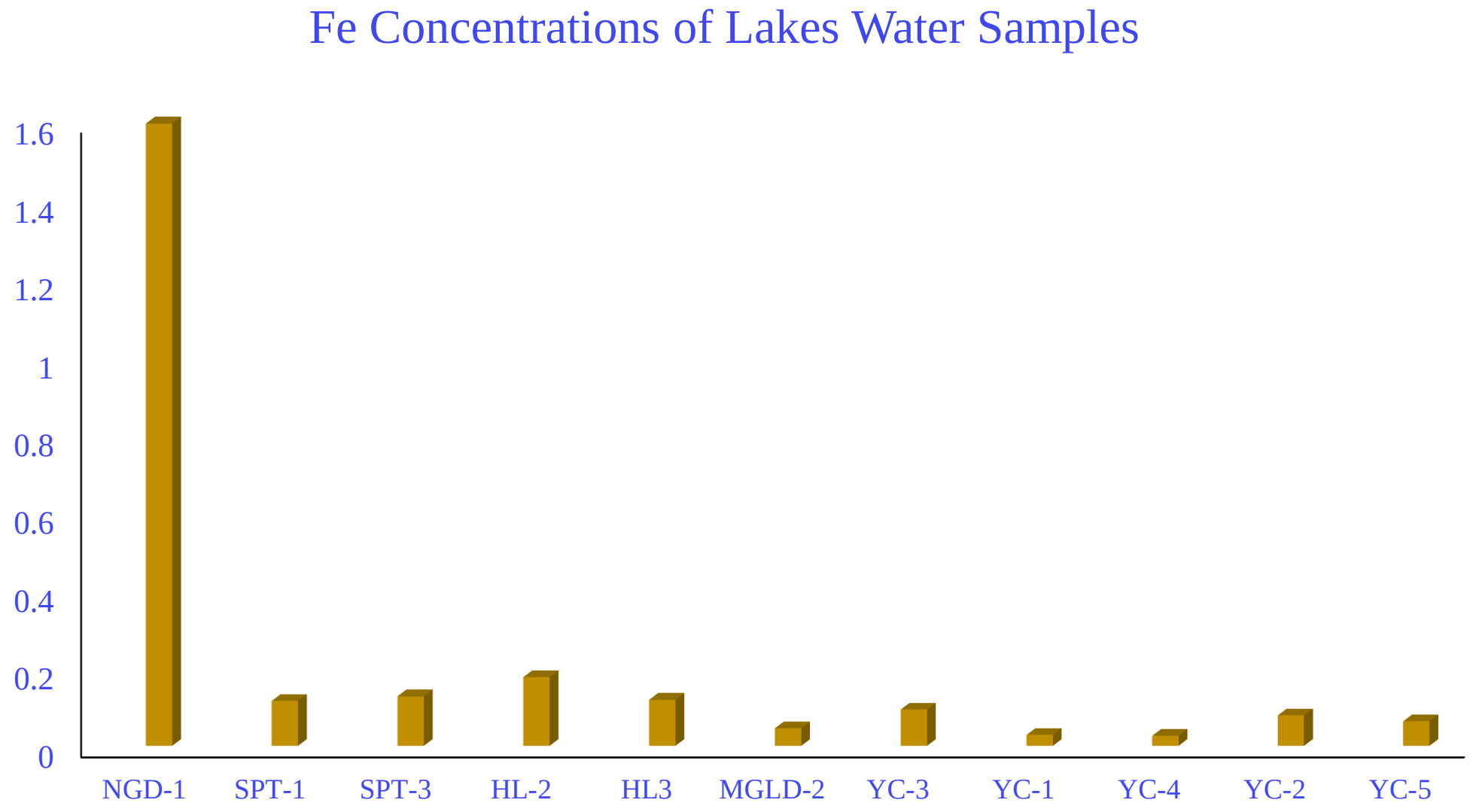

Figure 16 Fe Concentration of Lakes Water Samples

Conclusion

- In accordance with the results obtained by the AAS analysis of drinking water from 20 sites in Yangon area, it was found that all drinking waters contain only non-toxic elements except Lead (Pb).
- Although a little amount of the toxic element Arsenic (As) consists in some water samples, it is much lower than the guide line value for health significance and content of it in drinking water can be neglected.
- But the concentrations of Lead (Pb) which is another toxic element in samples of all tap waters and tube well waters from South Dagon Township were observed in considerable amounts and greater than the guide line value for health which is recommended by the World Health Organization.

- Moreover environmental monitoring should be carried out including that for lead in air, for lead in soil and in dust in urban residential streets, schools, grounds and parks and for lead in food, water from the tap and beverages.
- There are also adventitious or unexpected sources of lead such as paint in old houses.
- Such sources of lead from a hazard particularly for young children.
- There is a possible risk of absorption of lead in the remodeling of old houses, the burning of old painted woodwork and the leaching of poor glazes.
- Therefore such adventitious sources of lead should also be surveyed.
- Concentrations of Calcium in all water samples were found as a major element.

- It was also found that Calcium can be considered as a basic element for classification of rainwater and underground water.
- Therefore, it is recommended that the water should be boiled thoroughly and filtered before drinking in the respective areas.
- The study may reflect some of the environmental problems that can occur in the near future.
- It is hoped that this study will be a primary source of information or as an indicator to that possible actions and pollution control should be undertaken and to what extent.


THANK YOU