



China's Eagle Strike-8 Anti-Ship Cruise Missiles

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Cold Wars 2013*

*Admiralty Trilogy Seminar
Presented by:
Clash of Arms Games*





Outline

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- ◆ **Recognition Features**
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 - Reverse Engineered Exocet
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- ◆ **Conclusions**





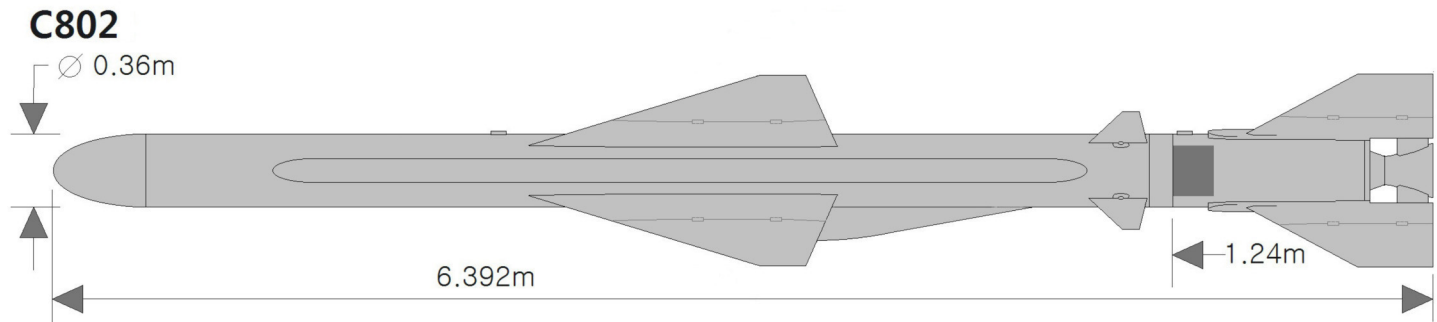
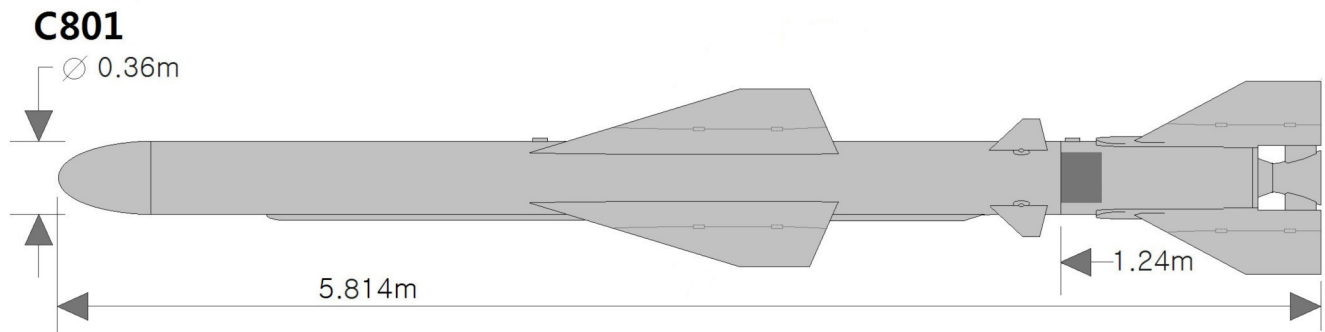
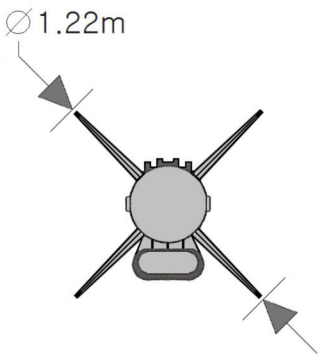
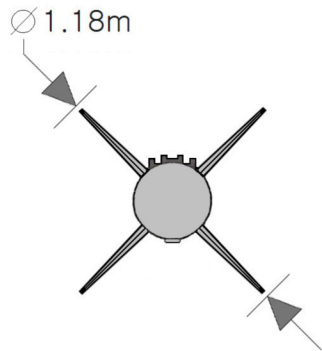
Designation Confusion

| PLAN Designation | Export Designation | Accuracy |
|------------------|--------------------|----------|
| YJ-1 | C801 | × |
| YJ-12 | C801A | × |
| YJ-2 | C802 | × |
| YJ-21 | C802A | × |
| YJ-8 | C801 | ✓ |
| YJ-8A | C801A | × |
| YJ-81 | C801A | × |
| YJ-8K | C801K | × |
| YJ-8Q | C801Q | × |
| YJ-82 | C802 | × |
| YJ-82K | C802K | × |
| YJ-83 | C803 | × |
| YJ-83K | C803K | × |

- ◆ Myriad of designations for the YJ-8 family in the open press
 - Ying Ji-8 means Eagle Strike-8
- ◆ The vast majority are incorrect
- ◆ Summarized popular list in table
 - Only one correct designation pair
 - Single red entry represents an incorrect designation
 - Two red entries indicate either both designations are incorrect for the YJ-8 family or an incorrect linkage is made between the two designations
- ◆ Clearing the confusion is essential to understanding the missile's identity, and who uses it
 - PLAN missiles are YJ-8 series
 - Export missiles are C800 series



Recognition Features



◆ Three significant recognition features

- C802 has a longer fuselage aft of the wings to accommodate the TRI-60 turbojet
- C802 also has a scoop inlet for the turbojet, C801 doesn't as it is rocket propelled
- C802 has two external flank cable runs, C801 has only one on the missile's underbelly



YJ-8: China's *Flying Fish*



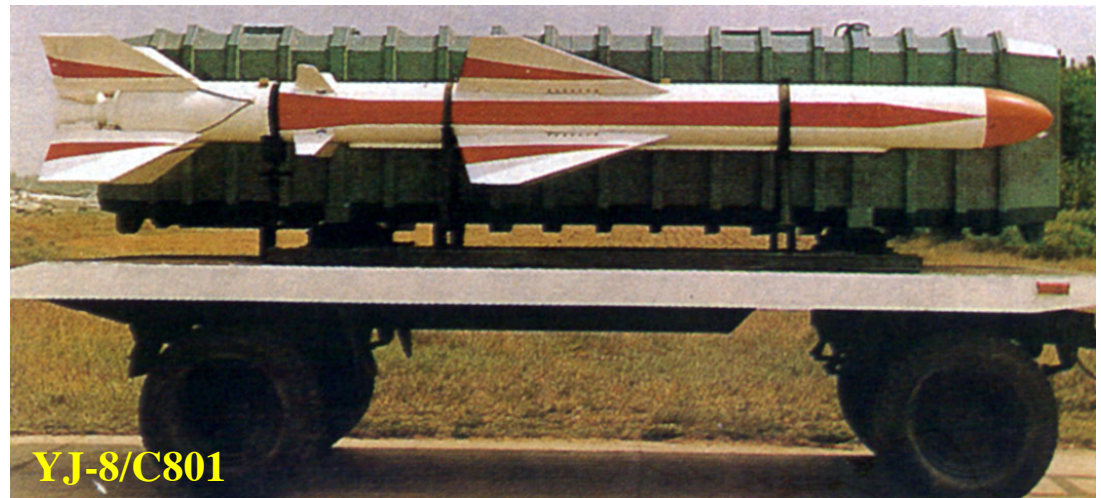
YJ-8 being loaded on the
Type 033G Mod Romeo SSG

- ◆ Radical departure from the liquid fueled rocket P-15 (SS-N-2) based missiles
 - Development began in September 1976, however, solid rocket work began mid-1960s
 - Flight testing completed by 1985
 - Reached Initial Operational Capability (IOC) in 1987



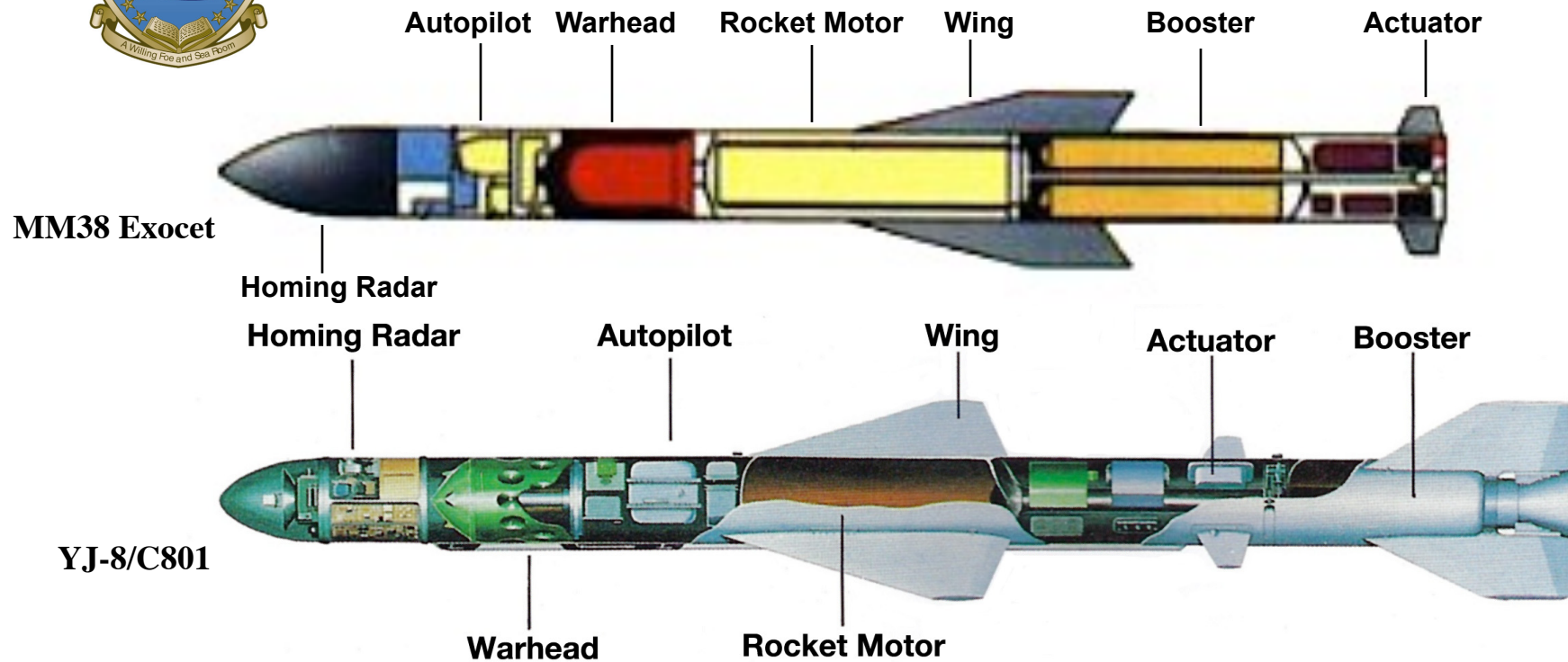
China Reverse Engineers The Exocet

- ◆ Origins of the YJ-8 are somewhat mysterious
- ◆ Several defense analysts argue the YJ-8 is a reverse engineered Exocet
 - Overall configuration similarity
 - Use of an externally ribbed launch container
- ◆ Didn't help that many Chinese articles called their missile the "Flying Fish"
 - Exocet is French for flying fish





Similar Requirements Yield Similar Results



- ◆ Other defense analysts believe the YJ-8 is the logical result of a missile that has similar requirements to the MM38 Exocet
 - Point to differences in overall size: YJ-8 is slightly larger, both in length and diameter
 - Significant disparity in rocket motor design
 - Exocet has booster and sustainer housed within the fuselage
 - YJ-8 has an internal sustainer, but a separate and jettisonable booster



Independent Development Hard To Support

- ◆ PRC weapon systems development strategy has relied heavily on the acquisition of foreign systems
- ◆ Reverse engineering is an acknowledged method of reducing technological risk, as well as saving time and money
 - Select systems and technologies that are known to work
 - Greatly shortens the research phase, jumpstarts the development process
 - A logical approach for a country that has to close a significant gap in military capabilities quickly and with limited resources
 - Does not require the indigenous system to be an exact copy
- ◆ China could have done all the R&D itself, but it would have taken longer, cost more, and had a higher risk of failure
- ◆ China's leadership appears to have made the choice to acquire foreign systems or technology, study them thoroughly, then build their own
 - Enabled PRC to get advanced systems faster and at a lower cost



Is the YJ-8 China's Exocet?

- ◆ YJ-8 design was at the very least heavily influenced by the MM38, if not an outright *modified* copy – it is not an exact duplicate
- ◆ Operational characteristics are a better indicator of the degree of influence than physical observables or component arrangement
 - Range is identical at 42 km
 - Speed is very similar (Exocet: Mach 0.93, YJ-8: Mach 0.90)
 - Warhead is identical at 165 kg
 - Very similar flight profile, both are sea skimmers (Exocet: 2.5 – 8 m, YJ-8: 5 or 7 m)
 - Exocet was the world's first sea skimming missile with an advanced radar altimeter
 - For China to replicate this ability in about seven years implies access to proven technology
 - A Western industrial country in the 1970s would have had difficulties meeting this goal
- ◆ An article in the Chinese Shipborne Weapons journal implies their engineers had access to Exocet technology
 - Exocet flight control gave Chinese experts “great inspiration”
 - Suggests China had a missile, flight control components, and/or detailed schematics



YJ-1 Designation



- ◆ Early Western reporting on the YJ-8 referred to it as the YJ-1, supposedly linking it to the export C801 designation
- ◆ The YJ-1 designation for the YJ-8 missile is incorrect
 - PLAN designation for an unsuccessful supersonic ship and aircraft launched ASCM
 - Export designation is C101



Limited Deployment



Wuhu, Jianghu III (Type 053HT) frigate

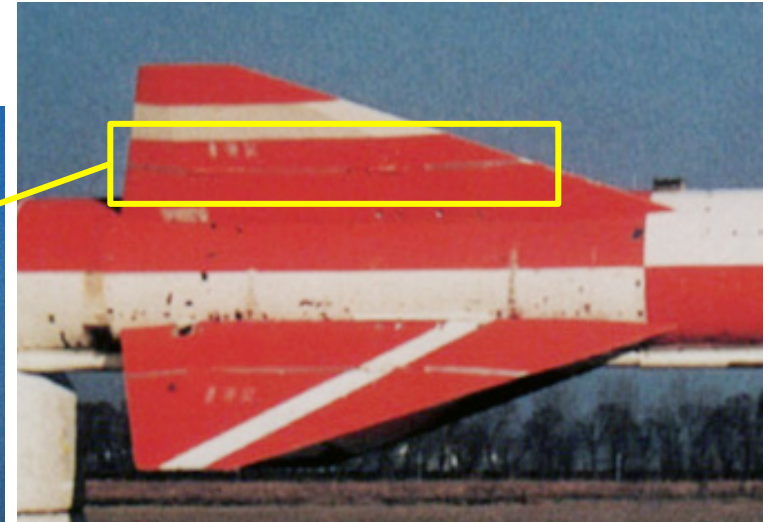
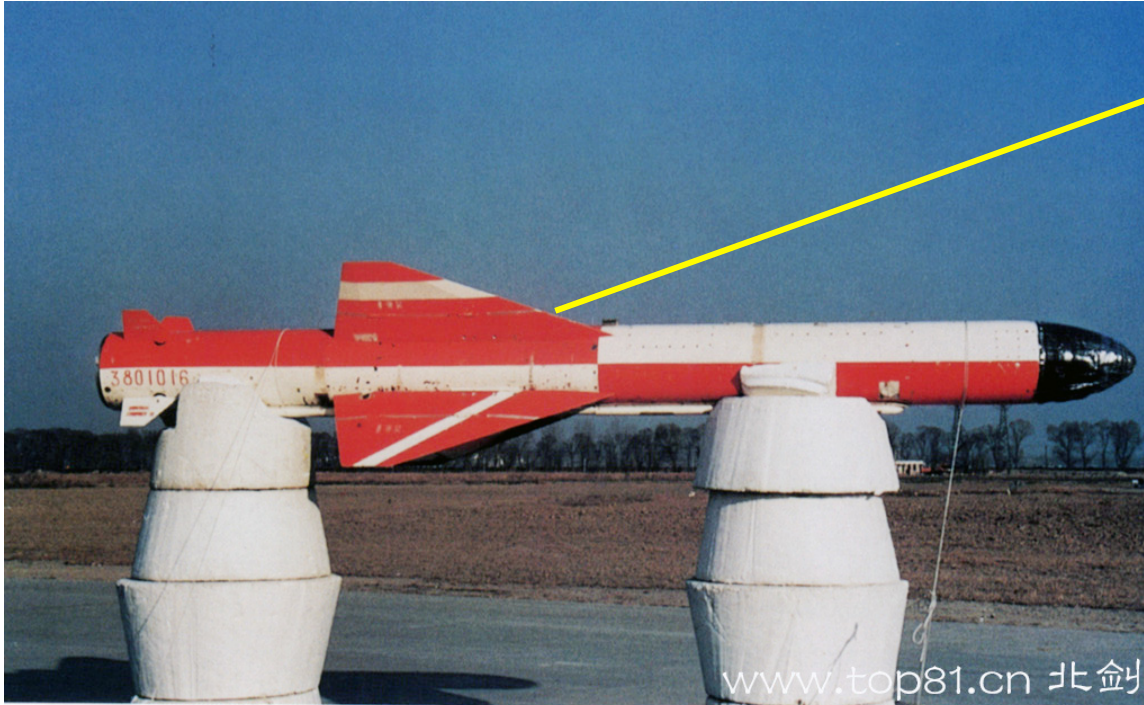


Mod Romeo (Type 033G) submarine

- ◆ YJ-8 reached IOC in 1987
- ◆ Deployed on only three platforms in the PLAN
 - Two Type 053HT Jianghu III frigates
 - *Huangshi* (535)
 - *Wuhu* (536)
 - Single Type 033G Mod Romeo submarine
- ◆ Limited export as well
 - Thailand's four Type 053HT Jianghu III frigates
 - Yemen's three Type 021 Hounan guided missile patrol boats



YJ-8A: Folding Wing Variant



YJ-8A 导弹隐身技术测试

- ◆ YJ-8A appeared very quickly after the YJ-8 entered service, reaching IOC in 1992 or 1993
- ◆ Only visible physical difference was the folding wings and booster fins

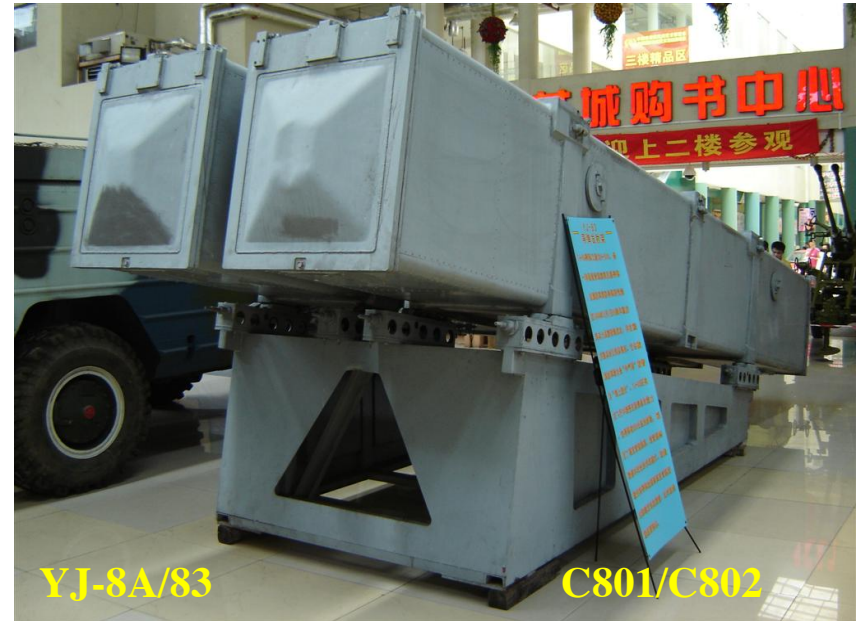


YJ-8A: Why the Change?

- ◆ No reason has been given for the very limited deployment of the original fixed-wing YJ-8 missile
 - No reports of technical problems or dissatisfaction with the YJ-8's performance
 - Historical accounts of the YJ-8 development indicate flight tests were quite successful
- ◆ YJ-8A stored in a smaller, non-ribbed launch canister
 - Same canister could be used by C802 and YJ-83 missiles
- ◆ YJ-8A was reported in Western press as having a longer range, 70 – 90 km
 - Assumed missile was reversed engineered MM40 with folding wings (70 km)
 - YJ-8A dimensionally the same as the fixed wing YJ-8, MM40 is 0.6 m longer than MM38
 - Concluded increased range due to a more energetic solid rocket fuel
- ◆ Original YJ-8 rocket motor took 8 years to develop and test
 - Initial R&D took 10 – 12 years before YJ-8 solid rocket motor work even began
 - To suggest China could develop an entirely new fuel and field it in 7 years strains credibility to the breaking point – would be difficult for a more advanced Western country
 - *China had already decided on an air breather solution to achieve greater range*



Launcher Configurations





YJ-12, YJ-81, C801A Designations



- ◆ The designations YJ-12, YJ-81, and C801A were often used in the Western press to describe an “extended range” C801 – all three are inaccurate
- ◆ YJ-12 is linked to the original YJ-1, repeatedly described as a supersonic missile - first picture appeared in January 2013, more like YJ-91 than YJ-8
- ◆ YJ-81 is a valid designation, but it is for the air-launched variant of the YJ-8
- ◆ C801A designation never seen on CPMIEC arms show brochures and displays



C801: One Export Designator, Two Missiles



- ◆ Both the fixed wing YJ-8 and the folding wing YJ-8A have been advertised as the export C801 missile
 - Folding-wing C801 shown at arms shows throughout the 1990s and up to 2003
- ◆ All CPMIEC advertised performance characteristics, including range, is the same between the two versions



YJ-81: Air-Launched Variant



- ◆ PLAN had a keen desire for an air-launched version of the YJ-8
 - Short aft section, no inlet scoop, single underbelly cable run = solid rocket variant
 - Near simultaneous development with ship-launched version
 - Flight testing began in mid-1980s, IOC in 1989
- ◆ YJ-8K designator is incorrect, a good try by a knowledgeable outside source
 - “K” reportedly means “Kongjun” or air force, denotes an aircraft weapon in this case
- ◆ Export variant is the C801K



YJ-8: Submarine-Launched Variant



- ◆ PLAN strongly desired to develop a submarine launched missile
 - Styx-based missiles too big, volatile liquid fuel too dangerous
 - Small solid rocket-fueled YJ-8 was just what the PLAN was looking for
- ◆ Modified Romeo Type 033G submarine delivered in 1983
 - Began firing trials in 1985, launch system appears to have functioned adequately
- ◆ One fatal flaw – submarine had to surface to fire
 - Vulnerable to detection and attack before it could get all its missiles off



Torpedo Tube Launched Options



UGM-84 Harpoon

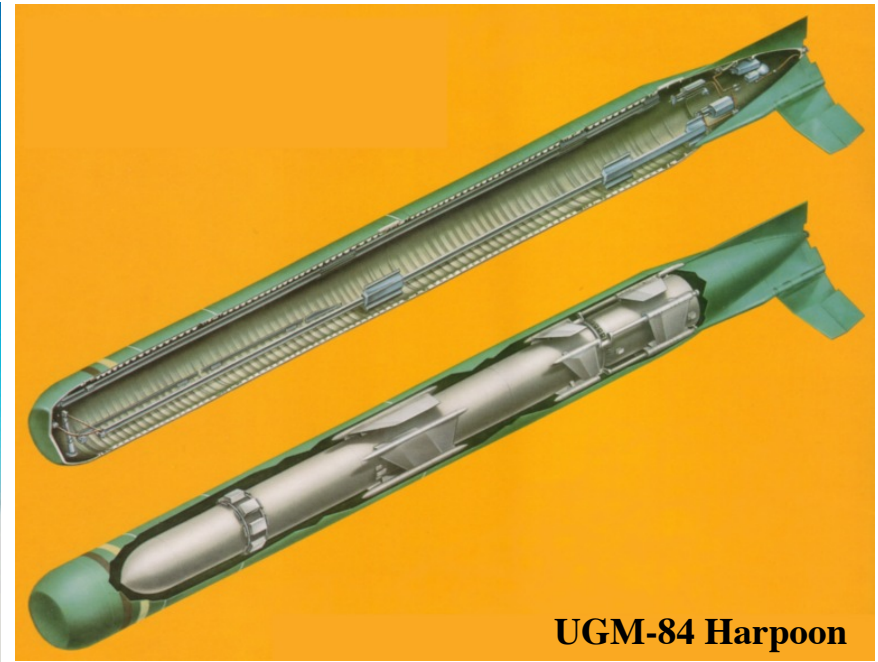
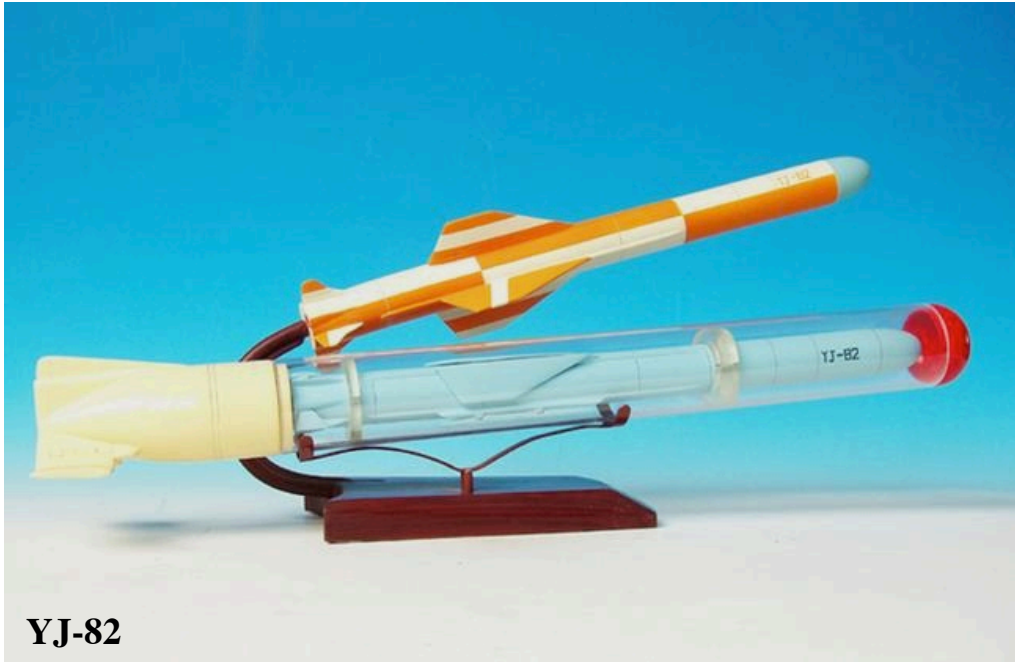


SM-39 Exocet

- ◆ PLAN chose a torpedo tube launch approach over external tubes
 - Alleviated many complicated submarine design issues, but limited their options
- ◆ Only two torpedo tube launched ASCMs in the 1980s
 - French SM39 – Powered capsule boosted missile in to the air before launch
 - U.S. Harpoon – Buoyant, unpowered capsule, missile launched after canister breaches



Harpoon Canister Knockoff



- ◆ At the 2004 Zhuhai Airshow China exposition – CPMIEC displayed an image of the YJ-82 and what appeared to be an identical copy of the U.S. submarine-launched Harpoon canister
- ◆ Harpoon canister is 6.1 meters long, Chinese model scale is very similar
 - Harpoon missile is 4.635 m long with booster
 - YJ-82 missile is 4.574 m long without booster



Harpoon Canister Knockoff



UGM-84 Harpoon Canister



YJ-82 Canister

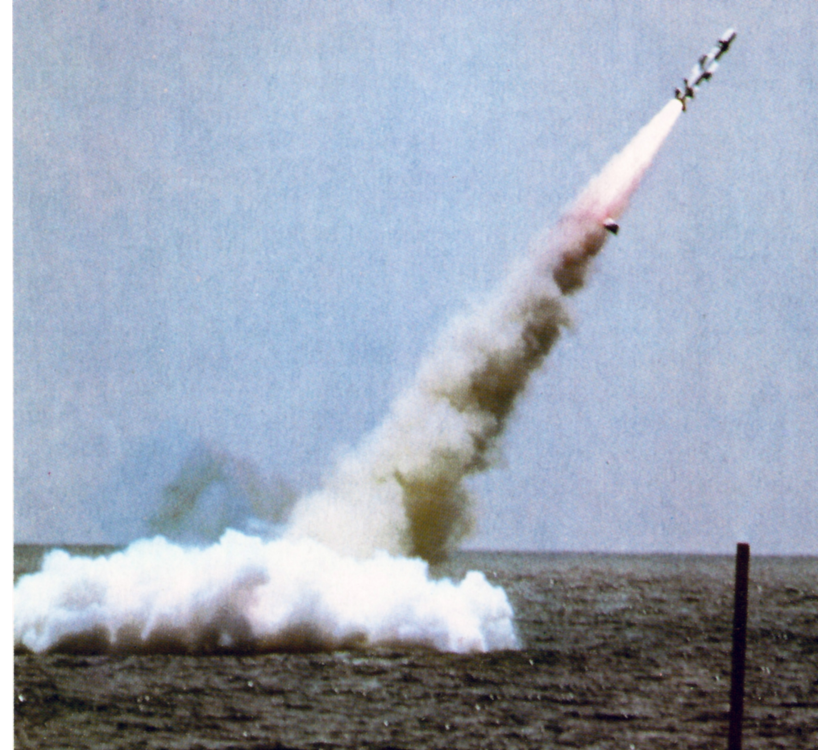
- ◆ Pakistan was the most likely source of submarine launched Harpoon technology transferred to China
 - *Agosta* and *Daphne* class subs modified to be Harpoon capable in 1984 – 1986
 - Growing relationship due to India concerns
 - One can easily envision a quid pro quo for Chinese technical assistance in the ballistic missile and nuclear programs



Harpoon/YJ-82 Test Firings



YJ-82



UGM-84 Harpoon

- ◆ First test shot in 1997 from Song Hull 1, reportedly didn't go well
- ◆ Multiple test launch photos show YJ-82 doesn't have a booster
 - With sustainer performing both functions, range will be shorter than 42 km



YJ-82: Submarine-Launched Variant



- ◆ Short section aft, no inlet scoop, no flank cable runs = solid rocket version
 - Missile model shows single underbelly cable run
- ◆ *Conclusively proves YJ-82 is not the indigenous version of the C802*
 - Radically different propulsion plants, very different launch platforms
- ◆ YJ-8Q designation also in error, a good try by a knowledgeable outside source
 - “Q” reportedly means “Qian” or submarine, denotes a submarine weapon in this case
- ◆ Export variant is the C801Q



C802: A Means to an End

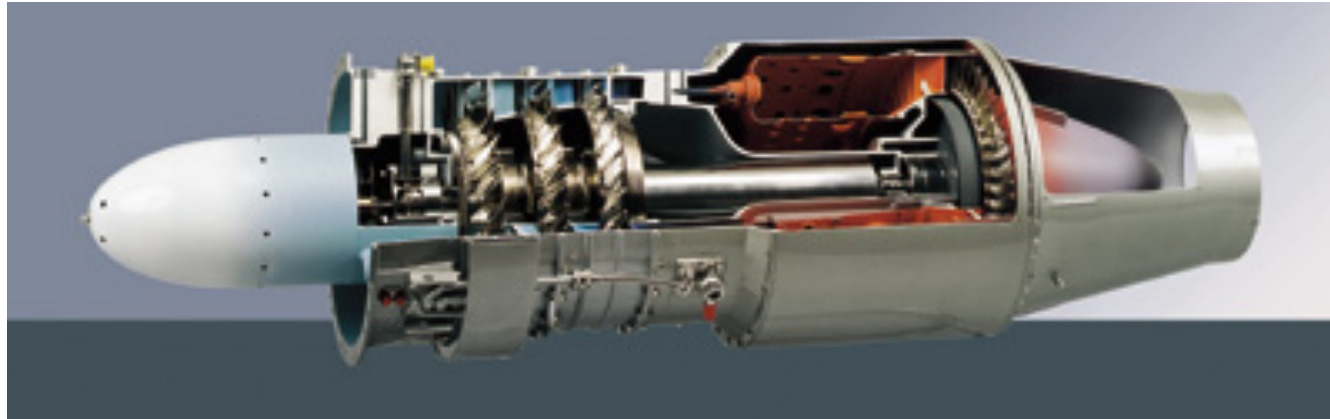
CPIEMC C802 Display Model



- ◆ Even as the YJ-8 was undergoing flight tests, the Chinese knew they wanted to extend the missile's range
 - Decided on an air breather solution, not another solid rocket motor
- ◆ The C802 has the extended section aft of the wings, the scoop inlet, and the flank cable runs indicating this is a turbojet propelled missile
- ◆ Export weapon only, never adopted by the PLAN
- ◆ A means to provide funding to pay for the missile they wanted, the YJ-83



Solution to Extended Range



TRI 60-2 Turbojet Engine

- ◆ China contacted Microturbo SA in France during the mid-1980s
 - Microturbo SA delivered the first shipment of TRI 60-2 turbojets in 1987
 - Recall the YJ-8 reached IOC in the very same year
 - Three shipments of 50 engines were made between 1987 and 1996
 - Soon after the 1987 shipment, China began a reverse engineering program to produce the engines indigenously
 - In the meantime, China could sell missiles with the French supplied turbojets
- ◆ The TRI 60-2 turbojet has a maximum rated speed between Mach 0.7 and 0.9
- ◆ Increased the C802's range to 120 km, nearly three times that of the YJ-8
- ◆ Warhead, navigation, and radar homing subsystems remained essentially unchanged – CPMIEC brochures claim some additional ECCM features



Iran: The First Big Customer



C802

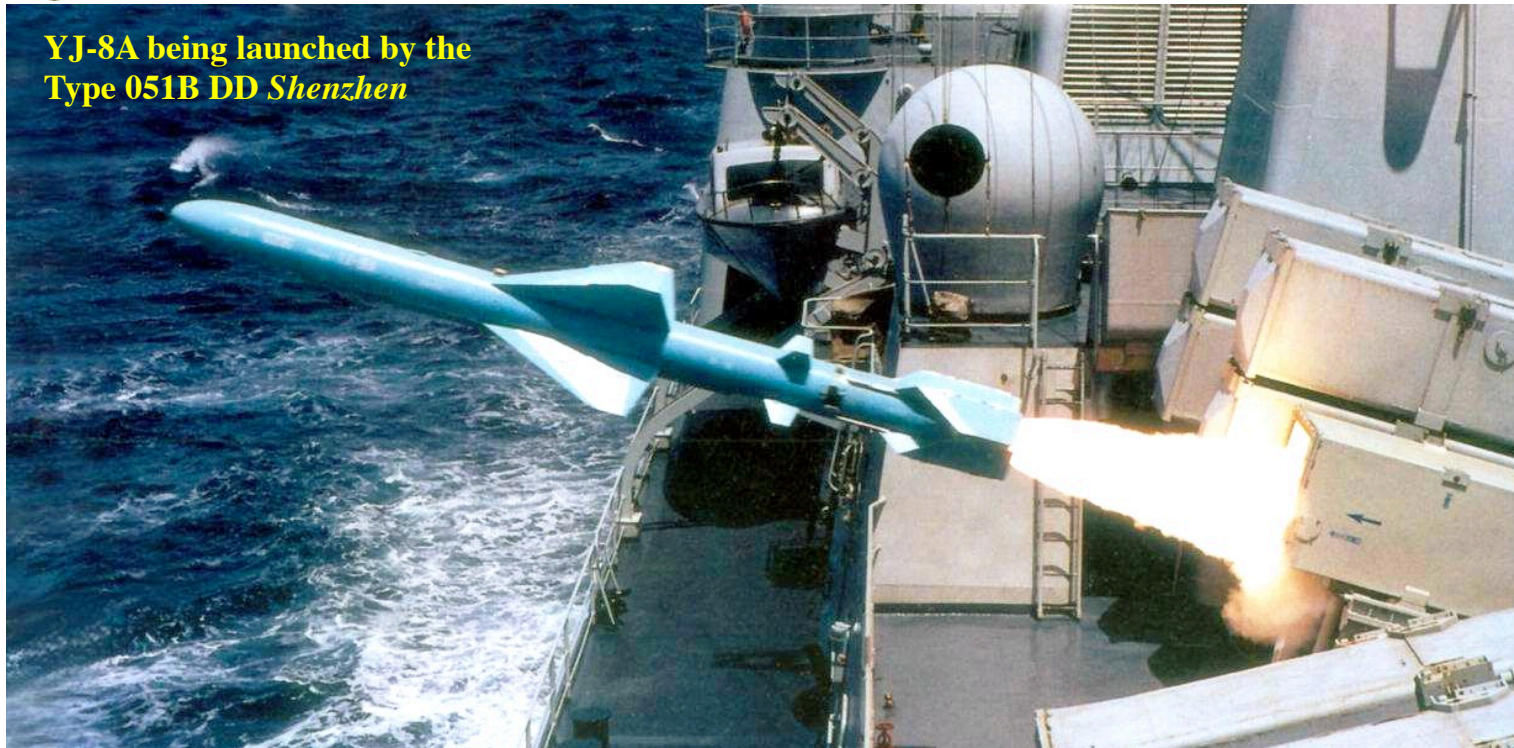
C802K



- ◆ By 1990 - Iran was negotiating with China to purchase 200 missiles
 - About 100 each of C801 and C802 ASCMs
 - Ship, coastal, and air launched versions
- ◆ First evidence the C802 had reached IOC was in late November 1995, when a C802 was launched during Iran's Saeqa-4 exercise



YJ-8A: PLAN's Initial Mainstay



YJ-8A being launched by the
Type 051B DD *Shenzhen*

- ◆ There is no evidence the PLAN ever adopted the C802
 - YJ-8A was the primary ASCM during the 1990s and early 2000s
- ◆ China didn't become proficient at producing the TRI 60-2 until 1996-97
 - Rarely accepts a weapon into wide scale use unless they can build it



YJ-2, YJ-82, YJ-82K Designations



- ◆ YJ-2 is also an early 1990s creation often used by the Western press
 - Assumes a relationship between YJ-2 and C802 that is incorrect
 - No photographic evidence of a missile with the YJ-2 designation
- ◆ YJ-82 designation has already been discussed
- ◆ YJ-82K is an incorrect designation for the air launched version of this missile, the correct designation is C802K



YJ-83: PLAN's Main ASCM



- ◆ The YJ-83 showed up on the scene without any advance warning
 - No actual missiles seen at the National Day Military Parade in Beijing in Oct 1999
 - Only the ship-based launch canisters on the back of a flat bed truck were shown
 - Mockup display missiles wouldn't be seen for a number of years
 - Note the YJ designation on the parade missiles, not C802 or C803
- ◆ Wild claims about the missile's performance began showing up on Internet blog sites soon thereafter – supersonic, GPS, data links



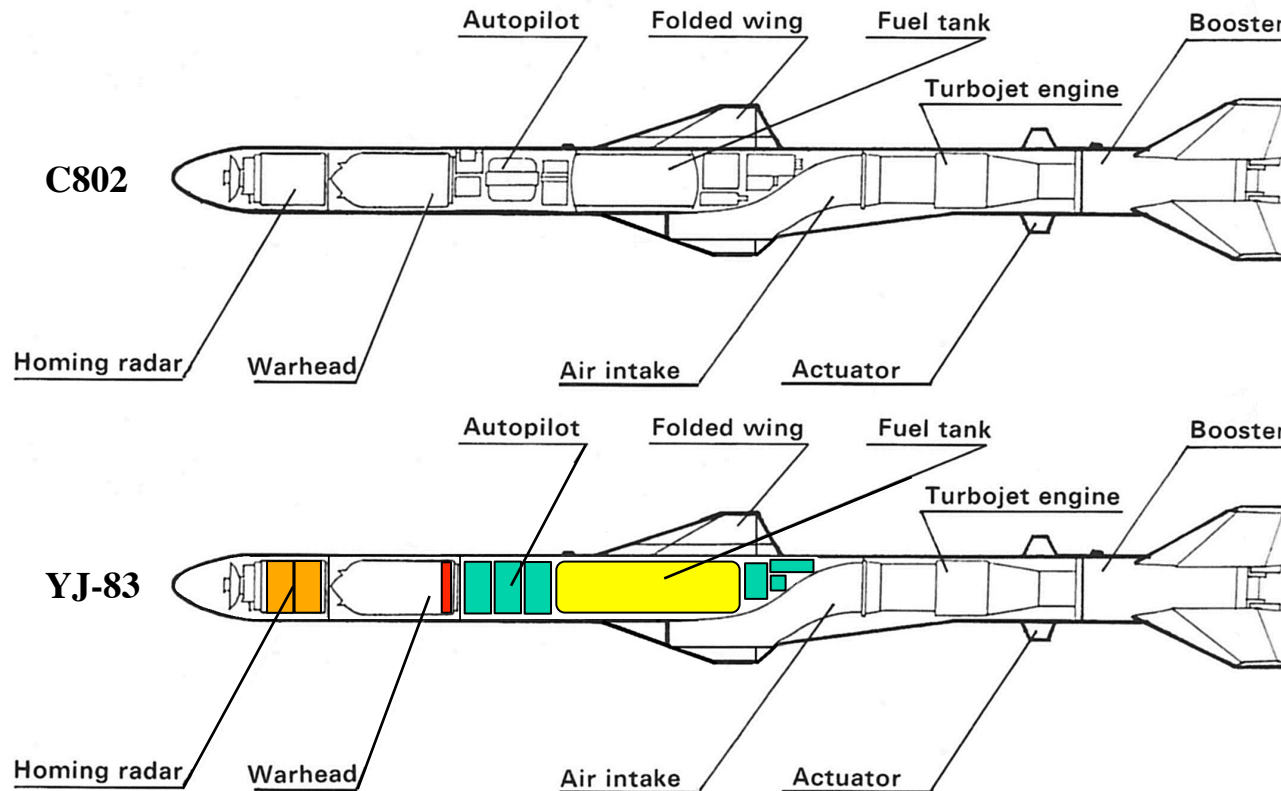
YJ-83: PLAN's Main ASCM



- ◆ The development of the YJ-83 is somewhat blurred
 - Closely linked to the C802 as they share a common propulsion system
- ◆ Final design was probably frozen in 1994 after the Chinese were confident the C802 would fly properly
- ◆ YJ-83 passed quickly through flight testing, likely reached IOC in 1998
- ◆ The TRI 60-2 turbojet essentially defines the YJ-83's size and form
 - Photos of C802, YJ-83, C802A show they are virtually the same length



Differences Between C802 and YJ-83



- ◆ With propulsion plant, warhead set, electronics only other area for improvement
 - YJ-8/8A used hybrid computers for navigation, autopilot, and radar seeker
 - Mixture of digital and analog components, only radar altimeter was fully digital (direct Exocet influence)
 - Inertial reference unit (IRU) used small bulky mechanical gyros and accelerometers
- ◆ Replaced electronics with digital microprocessors and a compact strap down IRU
 - Space available for more fuel, increases the range to 180 km, and a larger 190 kg warhead



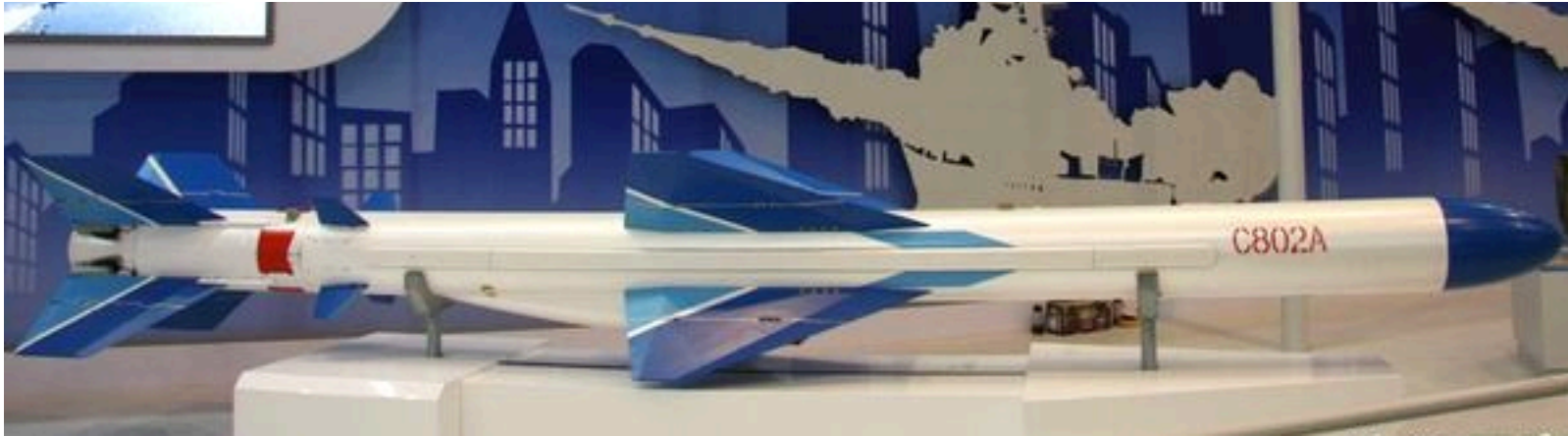
YJ-83K: Air-Launched Variant



- ◆ YJ-83K is the longer ranged (220 – 250 km) air-launched variant
 - Can be carried by small tactical aircraft (JH-7), as well as large bombers (H-6)
 - Photos of missiles without cable runs are dummy training units
- ◆ Submarine launched version, YJ-83Q, has not been seen nor is it likely it ever will be
 - YJ-83 is about 0.5 m longer than YJ-8, and YJ-83 requires a booster to get airborne
 - Canister would be on the order of 8+ m long, and wouldn't fit in Chinese torpedo tubes
 - Indigenous Chinese submarine designs have torpedo tubes with lengths on the order of 7.1 m



C802A and C802AK Export Missiles



- ◆ The export variant of the YJ-83 is the C802A – **NOT** the C803
 - Based on the flawed assumption that YJ-81 = C801, YJ-82 = C802, therefore, YJ-83 = C803
 - Export model of the YJ-83K is the C802AK
- ◆ C802A wasn't displayed until the DSEi 2005 arms show in London, England
 - Seven-year delay likely due to production limitations and the need to replace YJ-8As



Does a C803 Missile Exist?



- ◆ Since about 2002, the “C803” designation has worked its way into just about every Western naval systems reference book and article
 - Yet in over 10 years of reporting, there is no formal evidence to support its existence
 - No CPMIEC brochure, placard, model or display has ever been seen with the “C803” designator
- ◆ Zhuhai Airshow China 2010 and 2012 expos displayed numerous anti-ship missiles – the C803 was conspicuous by its absence



Is the YJ-83 Supersonic?

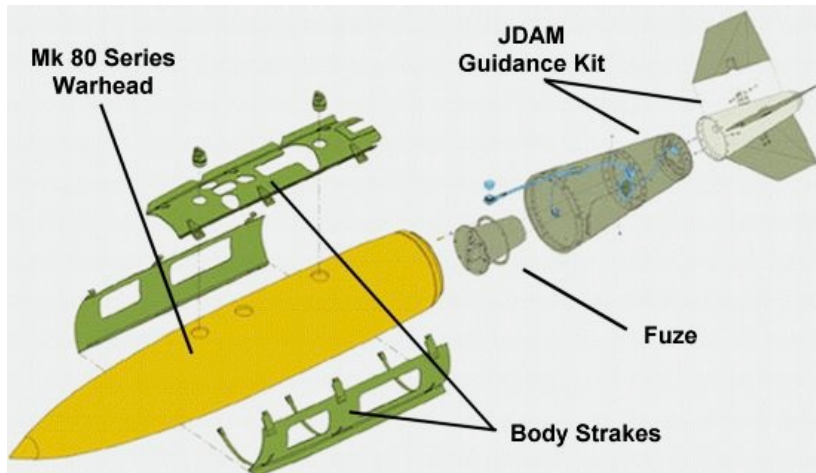


- ◆ The YJ-83 is most definitely a subsonic missile
 - TRI 60-2 has a maximum rated speed between Mach 0.7 and 0.9
 - Supersonic drag is heavily influenced by the shape of the missile's nose cap
 - YJ-83 has a low fineness ratio, drag coefficient about twice that of a sharper nose
 - Turbojet scoop inlet is a fixed geometry inlet - all missiles with this inlet design are subsonic (C802, C602, and C705) and the inlet lacks an upper diverter to isolate it from shockwave interactions



Does the YJ-83 have GPS?

U.S. JDAM GPS Guided Bomb



C602 ASCM



- ◆ The first GPS-directed ordnance is the U.S. Joint Direct Attack Munition
 - Began flight testing in 1996, reached IOC in 1998, first used in early 1999
- ◆ An in depth Chinese paper in 1995 acknowledged the benefits of GPS
 - China didn't possess the technical capability in the mid-1990s to employ GPS in munitions
 - R&D on ring laser gyroscopes on going, had to purchase GPS receivers from other countries
 - Concerns about the accuracy of the signal, i.e. Selected Availability
- ◆ YJ-83 reached IOC in 1998 as well, including a GPS feature makes little sense
- ◆ C802A brochure makes no reference to a GPS function, C602 brochure does



Does the YJ-83 have a Data Link?

AKD-88 EO Variant



CM-802AKG

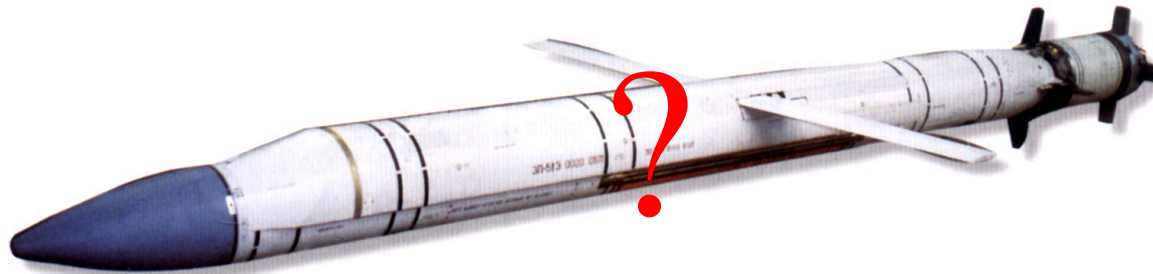


- ◆ Before the late 1990s, some Soviet ASCMs and the Otomat had a limited data link
 - U.S. and Israel would field full two-way data links in their Harpoon upgrades in early 2000s
- ◆ C802A brochure doesn't mention a data link – quite the opposite, “fire and forget”
 - 2010 brochure mentions ability to use four attack paths with three waypoints for the first time
- ◆ Some YJ-83 based missiles do have data links, all ground attack weapons
 - AKD-88 first seen in 2006, CM-802AKG in 2010: 8 – 12 years after the YJ-83 entered service



Is There Another Missile?

- ◆ Can't ignore the repeated claims in Western press and on Chinese Navy blogs
 - Begs the question: "Is there another missile with these performance features?"
- ◆ US DoD 2010/2011 annual report to Congress mentions an advanced ASCM in development and testing, CH-SS-NX-13, to be fired from Chinese submarines
 - Most likely a torpedo tube fired weapon
 - Some evidence also suggests the weapon could be launched from a ship's vertical launcher
- ◆ Shift in flight profile from all supersonic to subsonic cruise, supersonic attack
 - Reduces the field of possible options to one – Russia's 3M54 Novator Alpha
- ◆ Recent Chinese blog discussions have suggested a new missile with the designation YJ-18 is the Chinese version of the Russian Club
- ◆ A program start date around 2000 is consistent with the YJ-83 claims





The YJ-8 Family Untangled

| PLAN Designation | Export Designation | IOC | Launch Platform | Length (m) | Weight (kg) | Maximum Range (km) | Speed (Mach) | Cruise Altitude (m) | Terminal Altitude (m) |
|------------------|--------------------|----------|-----------------|------------|-------------|--------------------|--------------|---------------------|-----------------------|
| YJ-8 | C801 | 1987 | Surf/Coast | 5.814 | 815 | 42 | 0.90 | 20 | 5 or 7 |
| YJ-8A | C801 | 1992-93 | Surf/Coast | 5.814 | 815 | 42 | 0.90 | 20 | 5 or 7 |
| YJ-81 | C801K | 1989 | Air | 4.65 | 610 | 50 | 0.90 | 20 | 5 or 7 |
| YJ-82 | C801Q | 2003 est | Sub | 4.57 | 610 est | 30-34 est | 0.90 | 20 | 5 or 7 |
| | C802 | 1994-95 | Surf/Coast | 6.392 | 715 | 120 | 0.80-0.90 | 20 or 30 | 5 or 7 |
| | C802K | 1997 est | Air | 5.15 | 510 est | 150-160 est | 0.80-0.90 | 20 or 30 | 5 or 7 |
| YJ-83 | C802A | 1998 | Surf/Coast | 6.383 | 800 | 180 | 0.80-0.90 | 20 | 5 or 7 |
| YJ-83K | C802AK | 2002 | Air | 5.14 | 595 est | 225 - 250 | 0.80-0.90 | 20 | 5 or 7 |

- ◆ A lot of confusion has been proliferated in published works and on blog sites
 - The YJ-8 family is particularly a tangled up mess, the table above presents a clearer picture
 - Likely not some disinformation program, just a lot of information that has been misunderstood
- ◆ If the YJ-8 is China's Exocet, then the YJ-83 is China's Harpoon Block 1C
 - Evolutionary weapon, not a quantum leap
 - A good solid ASCM that is supported by a targeting system that can conduct OTH attacks
- ◆ Detailed three-part article posted on Defense Media Network
 - URL Part 1: <http://www.defensemедianetwork.com/stories/chinas-eagle-strike-eight-anti-ship-cruise-missiles-designation-confusion-and-the-family-members-from-yj-8-to-yj-8a/>

Questions?

